CHAPTER ONE

INTRODUCTION

Background to the Study

The major objective of teaching and learning at any level is that teachers/instructors bring about changes in their students.The achievement of this objective is very much dependent on assessment which can be carried out through examinations, tests, interviews, and projects (Bukar, 1994). Based on this premise, Chiejile (2006) mentioned that a simplistic measure of quality of teaching is dependent on how effective and efficient the students carry out the learnt skills at the end of the course or programme of study. In other words, measurement of the learners' performance is a function of how well, proper and adequatethe assessment procedures are carried out. Where the opposite is the case, the objective or excellence desired in teaching/learning process may be difficult to achieve.

Any teaching capable of producing an intending result requires competence and commitment. Hence, Akilaiya (2010) opined that the achievement of high quality learning is consequent upon continuousprocess of assessment, although, it is not all the teachers that may have the requisite/ relevant skills as well as in the validity of such assessment. Okoro (2005) stated that any teaching done from a planned lesson must be examined for the achievement of the objective through test or other means of assessment of the students. This is solely, according to Tavakol (2014),to determine the degree or extent to which the objectives at the three domains (cognitive, affective and psychomotor) have been realized; utilizing say workshop environment.

Workshop practice is widely known and has been in use in school workshops as a technique or way of teaching technical subjects. It necessarily follows that, wherever this method of teaching is employed to teach students either in group or otherwise, there is necessity to engage some unique method of assessing such practices or activities (Okorie,1988& Ezeji, 1996). This way, practical work learnt will improve students' knowledge of tools and materials as well as develop skill and quality attitudes towards job. Consequent upon the above, the Federal Republic of Nigeria adequately emphasized the importance of practical work in technology education (FRN, 2012), especially at the basic level.

The Federal Government of Nigeria in 1992 established the National Business and Technical Examination Board (NABTEB) under decree 70 of 1993. Its mandate is to promote technical education throughout Nigeria and increase the quality and efficiency of the graduates of technical education systems through the award of national technical certificate (NTC) and advanced national technical certificate (ANTC). Towe (1995) highlighted that NABTEB actually restructured the existing curriculum and developed new one for technical colleges. Towe stated that the aim of the new document include enhancement of flexibility in the production of skilled personnel at all levels. In clear terms, the objective of the technical college programme is that students should be trained to acquire practical knowledge/skills required for their own well-beingand for national development. This simply means that the involvement of students in practical work in other to bring about production of things either single-handedly or in group calls for some measure of assessment. The clarion call on the concerned teacher is to realize the importance of coming up with ways and methods by which valid marks could be awarded in practical skills activities (Chiejile, 2006).

However, the process of practical skill assessmentis not easy as stated by Oranu in Chiejile (2006).The reason advanced for the uneasiness is that such assessment process involves passing value judgment on both tangibles and intangibles. These include those things that have something to do with human factors that are observable but with difficulty and which can be effectively examined by mere paper – and – pen kind of rating in order to determine what the learners are doing and how correctly those things are done.

Accordingly, it is stated that practical work cannot be actually assessed through oral or written examination of the students but such process of assessment need to have tasks to be done practically. Along this line, there is also the need to write out the statement about the degree of accuracy that is necessary in performing the tasks as well as the weighted values for each category of the observable skills.

The issue of interest is to really find out if there is any type of assessment that the teachers can use to give a true measure of the skills possessed by the learners and their ability to apply those skills.These technical teachers are of three categories, i.e. those who have B.Sc (Education), HND plus PGDE and FTC plus TTC. Towards this,Leighbody and Kidd (1968), Andrew and Erickson (1976), Brickbanner and Mortenson (1967) pointed out that there is only one type of assessment that the teachers can use to do this and it is called performance assessment. The opinion of these scholars is that such should take the form of process and product assessment using the most relevant criteria and tools. While process assessment is achieved through a close observation and following students all along the stages of the practical jobs being done, designed, constructed, assembled or fabricated till it is finished in the workshop, product assessment involves assembling already finished projects in the workshop. The achievement of this is contingent upon the ability of the teachers vis-à-vis their number of years of their experience to develop assessmentinstrumentas it is done in planning and implementation of curriculum and also to give their opinions about the rating of such assessment instrument.

Based on the above premises, it follows that students assessment in practical electronic cannot be based on the finished product alone;this is because such assessment would be subjective and therefore prone to abuse by the assessors. To overcome this challenge, researcher like Ezeji (1996), Nitko (2001) and Okoro (1991) have suggested that a very important criterion for objective and reliable assessment of practical works is to construct and use a well-designed performance assessment tool. This suggestion, if carried out ensures that the actual performance or activity of learners determines their progress in a given practical task. This idea will also play down the temptation of judging learners attitudes or personality by assessors. It was in this regard that Gbosi (2004) categorically stated that there is the need for the preparation of valid instruments so that teachers, especially the experienced ones will have the opportunity to generate and work with reliable data which will guide the students and their parents, in technical trades as radio and televisionand electronic. The development of such reliable instrument has three main involvements. These are adoption, adaptation and implementation. According to Okoye (2015), these three main steps are sub-divided into seven processes thus: objectives of the instrument, learning experiences expected to be gained while using the instrument, identification of instrument, formation of contents of instrument, validation of instrument, reliability of instrument and evaluation of instrument. For the purpose of proximity and precision in this study, these seven steps are compounded into four main processes for implementation as follows: determination of tasks, identification of practical skills, validation of the instrument and establishment of instrument reliability.

Radio, television and electronic work are an integral part of the National Technical Certificate (NTC) and Advanced National Technical Certificate (ANTC) curriculum and module specification in radio, television and electronic work.The NTC and ANTC programme curriculum is broadly divided into three components: general education, which accounts for 30% of the total hours required for the programme, trade theory, trade practice and related studies which account for 65%and supervised industrial training/work experience which accounts for about 5% of the total hour required for the programme. Federal Republic of Nigeria (2012) stated that this component of the course is compulsory for all full time students and may be taken in industry or in college production unit.

The paper also stated that the curriculum should contain the teacher's activities and learning resources required for guidance of the teacher.The main objective of the curriculum as succinctly put by Okoye (2015)is to increase the technological growth of the country; but the secondary school and very many technical teachers do not seem to possess adequate competence in the development and validation of instrument to achieve the curriculum objective (Chiejile 2006). These researchers' opinions about the need for technological competence of teachers to develop instruments in their subject areas was also corroborated by Okwelle (2014) who asserted that technical college and secondary school teachers do not have the needed skills and competence to develop an instrument to assess the practical performance of electronic students.

However, one serious gap arising out of the review of related research is that no study to the best knowledge of the researcher has specifically dealt with the issues of development and validation of instruments for assessing electronicpractical/tasks in technical colleges. This seems to neglect the much emphasis by Okoro (2005) that a valid and reliable instrument for the assessment of students' practical skills or dexterity in electronic tasks is of paramount importance. The need for this present study, therefore, is to device a measure that would assist teachers of electronic, especially in technical colleges, to be able to assess those necessary and component skills that the students in training need to display in the course of performing the practical job in a workshop setting.

Statement of the Problem

Technical colleges in the country offer many trade subjects including electronic as an integral part of the technical college trade programs. All the trade subjects are centred on the impartation of practical skills/competence as well as basic knowledge of science and technology to the students in the process of teaching and learning. As a result, it is very essential to determine students' progress in the process of acquisition of the knowledge and practical skills. However, competence cannot be adequately determined without a clear delineation of behavioral skills that are involved in the steps to take to achieve the final product (job).

What appears unfortunate is that electronic teacher hardly assessthe steps involved in practical activities, rather, a mere cursory look is taken and grades are assigned subjectively to students by the teachers (Akinseinde, 2016). The reason for this kind of assessment cannot be substantiated but it appears that those teachers are either reluctant or too busy to assess the various stages of individual student's work by making extra effort to prepare a definite assessment procedure.

On the other hand, Okwelle and Okeke (2011) in a study observed that marks are awarded to the students based on what the examiner or the teacher feels that students deserve. This method of awarding marks to students as the teacher feels is considered subjective (Okwelle, 2014). It is also observed that NABTEB uses a marking scheme checklist to assess students' performance in practical components of NTC examinations; the checklist merely highlights the major skills to be rated but lacks details of the various stages of specific skills involved in the process of carrying out the given tasks (Bukar, 2006). The assumption is that, in the absence of valid and reliable instrument for assessing practical projects, teachers do not take time to observe students closely and grade them as the assigned task are performed; and as a result students could become unsatisfied with any marks awarded by their teachers. The implication is that the scores and grades assigned to students in practical works by the teachers may not be true representative of students' performances. It is against these reasons that this study is designed to develop and validate an instrument for assessing students' practical performance in electronic as a trade subject in technical colleges.

Purpose of the Study

The main purpose of this study was to develop and validate an instrument that can be used to assess students' practical skills in electronicworks. In specific terms, the study was designed to:

1. Determine the tasks in electronic trades that would be included in electronic work test instrument (EWTI).
2. Identify appropriate practical skills for inclusion in an electronic work test instrument (EWTI) for use in technical colleges.
3. Validate the electronic worktest instrument (EWTI) for assessing students' practical work.

4. Establish the reliability of the work test instrument (EWTI) for assessing students' practical work.

Significance of the Study

This study will benefit electronic teachers, electronic students, researchers in technology and vocational education, curriculum planners in National Board for Technical Education and other educational agencies. How each entity will benefit is explained below.

The result of this study will be beneficial to electronic teachers who would assess students. The point of emphasis here is that the traditional teacher-centered assessment method is usually done without a standard procedure. It is believed that if this studyis accomplished, the result will contribute immensely to the work of electronic teachers by providing them reliable guideto assessing students' practical works inelectronic trades. The study so accomplished will become a veritable and ready instrument that would be used to assess technical college students in electronic works tasks.If the results of the study are functionally utilized to assess students' practical works, the assumption is that students too would feel happier that assessment is done using standard procedure. By this, students of electronic will be more confident on the validity of the grades received from the teachers while the teachers too would be satisfied.

It is also going to be of benefit to the students asthe assessment instrument will enable the students to improve on the acquisition of skills in practical works. The reason is that the instrument to be developed would contain skills to be practiced and while doing so students' interest would be aroused and sustained because of the objectivity that would be involved in assessing them in all the work areas.

The proposed instrument in this study would also assist the teachers to determine the abilities of students to perform to standard. It is assumed that, the final results obtained through the use of the instrument would also assist the teachers to properly identify areas of improvement in case of students' poor performance. In essence the grading of students in their academic performance would no more be subjective but to a very great extent guided by objectivity. Apart from these beneficiaries, researchers in vocational education, curriculum planners in National Board for Technical Education as well as other educational agencies will also benefit from the product of this study as it will serve as a basis to ensure that assessment instruments in vocational education are done objectively and to standard.

Scope of the Study

This study was delimited to the practical aspect of electronic work. The study could not cover the entire aspects of electronic that are theoretical such as oscillation and oscillations signal generation. Specifically, this study dealt with developing and validating an instrument for assessing student's practical performance in electronic projects covering areas in soldering, construction and assembling and inspection of circuits, electronic gadgets and equipment.

Research Questions

The study sought answers to the following research questions:

1. What are the tasks inelectronic work that should be included in an electronic test work instrument (EWTI)?
2. What test items are suitable for assessing students' practical work in electronic trades?
3. How valid is the electronic work test instrument (EWTI) developed for assessing students' practical work?
4. How reliable is the electronic work test instrument (EWTI) developed for assessing students' practical work?

Hypotheses

Two null hypotheses were formulated and tested at 0.05level ofsignificance:

1. Technical Teachersdonot differ significantly in their ratings of the test items to be included in electronic work test instrument (EWTI) based on their academic qualifications.

2. Electronicteachers donot differ significantly in their ratings on the tasks to be included in the electronicwork test instrument (EWTI) based on their years of teaching experience.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

The organization of this review of related literature is done under the following sub-headings:

Conceptual Framework

Assessment of Instrument

Development of instrument

Validation of instrument

Performance

Electronic Work

Technical Colleges

Theoretical Framework

Albert Bandura's Social Learning Theory

Jean Piaget'sTheory of Cognitive Development

Edward Thorndike's Theory of Learning

Theoretical Studies

Brief definition of technical and vocational education and training (TVET)

Use of Assessment Instrument on Students' Practical Assignment

Evaluation – Principles and Concepts

Reliability in instrument for assessing students' practical performance in Colleges

Assessment Procedure in Electronic Practical

Tasks in Electronic Practice

Importance of Instrument to measure Practical Learning Skills inelectronic work practicePresent Assessment Method of Electronic Workshop Practice

Related Empirical Studies

Summary of Review of Related Literature

Conceptual Framework

Assessment of instrument

Assessment of instrument, according to Ajayi and Abanobi (2016), refers to the process of using numerical data obtained through measurement in other to take informed decisions. This view also encompasses the process of defining, selecting, collecting, analyzingand interpreting qualitative information so as to improve the learning and development of students. Such assessment can be formal or informal, descriptive and objective. In other words, assessment of instrument is central to the practice of education and it is important to realize that good performance on high stakes instrument gives access to further educational opportunities and even employment.

For teachers and schools, it is a well assessed instrument that provides evidence of success of individuals and the institution through the use of different methods, strategies and sources to gather and record information about the performance of individual learners in the three domains of learning at specific intervals during the cause of training

The above depicts that assessment of instrument is an essential stock-taking aspect of the teaching – learning activities where determination of learning outcome is important. Okoye& Okwelle (2013)stated that this is the major reason that makes assessment of learners imperative for effective feedback wherever teaching –learning process takes place.

The Nigerian National Policy on Education (Federal Republic of Nigeria, 2012) stated that educational assessment and evaluation will be liberalized by basing them in whole or part on continuous (process) assessment of the progress of individual. The policy is also very clear in its guidelines as regards the type of continuous assessment instruments that should be adopted by states and schools nationwide.

Aside from the above, assessment in the view of Nkwocha (2004) is a mechanism whereby the final grading of a student in the cognitive, affective and psychomotor domains of behavior systematically takes account of all his performances during a given period of schooling. A point of interest to this study is the psychomotor component of the assessment process.

The psychomotor domain includes dexterity in body movement as well as the ability to use the body and the limbs. As stated by Ajayi and Abanobi (2016), the qualities of this domain are exhibited in setting up experiments, constructing projects, dismantling and assembling components and physical structures and the manipulation of physical devices.

Assessment in the psychomotor domains, like in the students' practical performancein electronic, is carried out by subjecting the student to practical test which is done in the workshop. As it is, the implication of this kind of assessment is that for a person to be well developed, he should be able to reason effectively (cognitive), behave in a socially acceptable manner (affective) and use the hands and other parts of the body effectively (psychomotor).

Development of instrument

Development as a concept here means the process of producing or creating something new or more advanced in other to make it more useful or purposeful in achieving objective orset of goals in a given situation (Hornby, 2015). This concept is very essential in the process of creating an instrument for assessing students' practical performance especially in electronic in technical colleges.

Development of instrument aims at creating a new instrument which will either enable research work not available using any existing instrument or will substantially improve research capability beyond what currently exists and in such a way that it opens up significant new and improved opportunities (Research Council, 2016). In other words, development in instrument is very important in relation to the measurement of outcomes of students whileexamining the achievement of the stated objectives (Okwelle, 2014).

The framework of development occurs in a variety of ways. It might involve the construction of a wholly new instrument fromits basic components or it might involve a substantial modification of an existing instrument. In some cases, it can also involve the integration of two or more existing instrument into a new combined one. The key issue here will then be that the proposed integration should lead to a technically non-trivial instrument with a capacity that is significantly higher than that of using the components instruments independently.

The above will be in order in so far as the education objectives will enable students to behave in certain expected ways through teaching and learning in a formal setting.These education objectives are to guide students' assessment, facilitate teaching and learning processes and give a good direction to the development of curriculum. Along this line,it is very important to state, explicitly the objectives as statement that will elicit expected learning outcomes. Without this in mind, it will be hard to develop or even identify any test instruments for measuring objectives.

There are many important concepts in instrument development as posited in the years gone-by by researchers like Thorndike and Hagen (1977), Tyler (1973) and Russell (1982) among others. These concepts centered on paying critical attention to the adequacy of the test items so that the right students' behaviour is achieved, the degree of precision the results would need to achieve the intended purpose;and to the appropriateness of the instrument to the age and developmental capacity of those being tested.

In line with these old researchers, the National Coalition for Electronics Education(2016) posited that before collecting any data, researchers will need to develop research instruments (the tools needed to collect data), and for this to be done effectively, the Foundation gave the following five points as important considerations in the framework of instrument development:

1. Starting with a statement about the focus and aims of the research project, how the person's data will be used, the confidentiality and how long the interview or survey will take to complete.
2. The necessity to use age – appropriate language.
3. Relevance of test questions in other to help the researcher to answer the research question. Any irrelevant ones would have to be discarded.
4. The use of appropriate scales is very important.
5. Ensuring that the questionnaire ask respondents for only relevant information such as age, gender. Much personal details should be avoided.

The Foundation also included that it is very important to agree on what to look for if the research work centers on carrying out observations. This could be done by designing an observation form. Aside from this, a good measuring instrument should have important psychometric properties. The two important ones are validity and reliability as noted by Chiejilewith an extension to usability aspects of the instrument. It is placed on record here that these properties are very essential and key in the process of developing an assessment instrument.

Validation of instrument

Another important concept in the title of this work is validation. It is a process of ensuring that the content of the instrument is brought to an acceptable level of acceptance especially when deigning one to measure/assess students' practical performance in electronic. DeVills (2003) opined that psychometrics is the construction and validation of measurement instruments and assessing if these instruments are reliable and valid forms of measurement. Going by this, it means that for any measurement to take place using questionnaire, such questionnaire must be evaluated very well before concluding that it has excellent psychometric properties, meaning a scale is both reliable and valid. In passing, Grimm and Yarnold (2000) also indicated that a reliable instrument will consistently measure the same construct and this can occur across testing sessions, individuals and settings. Whereas, a valid instrument measure what it says it is going to measure. If something is valid, it is reliable always. However, an instrument can be reliable without being valid.

Validity, according to Okoye (2015), refers to the extent to which a study actually captures or measures what it purports to examine. This is to say that an instrument will be valid if it fulfills the purpose(s) for which it is used and is usually examined by an analysis of the contents of the test or by a study of the relationship between test scores and other variables. Other researchers like Tuckman (1972), Gay (1981), Barrow and McGee (1973), Nwana (1982), Ezeji (1996), and Okoro (2005) discussed the issue of validity in many dimensions. All the discussions point to the fact that validity is one of the most important characteristics of an instrument talking about an instrument being valid for what and for whom it is meant for. There are many types of validity measures. According to Alvior (2013), one of the most commonly used type is construct validity. Others according to Kingsbury (2012), are content validity criterion – related validity and also that of face validity as identified by Okoye (2015).

On face validity, Renata (2013), indicated that it is used in reference to the appropriateness of the test items as viewed by the examinee. Ezeji (1996), also stated that face validity tells whether the test actually looks like what it should be. This implies that, face validity, is expressed in terms of the perception of the testee and other peopleabout the instrument. The way the test is seen to appear means alot in terms of whether the test items are childish for a test meant for adults or according Chiejile too much like a commercial school stuff when it is meant for technical school students.

Both face validity and content validity as described briefly above are the two kinds that this present study employs in conducting the research. Face validity is simply concerned with the extent to which the test measure what it purports to measure. A study by Alvior shows that if an employee is completing a measure of job satisfaction, but realizes that there are items that appear to be geared towards honesty or integrity, the validity of the job satisfaction measure may be diminished because of lack of face validity. In other words, this kind of validity is subjective in judgment and it is just to ensure that the test covers relevant content.

As for content validity, it focuses on the extent to which a test samples the work domain. For instance, a soldering test would be content valid when testing applicants for the position of instruments maintenance officers. The determination of content validity is done systematically by conducting a set of operations such as stating in categorical terms the specific content concerning the objectives and then explaining how the contents will have a good representation in other to develop test items.

However good content validity is, its value is not given in figures or numerical terms such as found in reliability expressed in correlational co-efficient. Thus, the determination of content validity is predicated upon the demonstration that the test items are a representation (sample) of the universe in which the test constructor’s attention is focused. This is obtainable, as stated by Ekpu (2001), whenever a group of experts come together to develop a set of items that covers all the important/key areas of the syllabus being measured.

Performance

Performance, according to Watts (2013), means commitment and competence. Hence, the achievement of high quality teaching and learning is a product of how practical job is done. According to Okoye (2013), practical work performance has been widely used in school workshops as a method of teaching technical subjects like electronic, metalwork and so on. When students are engaged in practical work to accomplish a given task, performance is in action and it calls for some unique method of assessment of the job at hand.

It is performance that improves students' knowledge of tools and materials and helps in developing skills and positive attitude towards work. It is in this regard thatthe Federal Republic of Nigeria stressed the importance of practical work in technical education (FRN, 2012).

Technical Colleges

These are colleges established, especially by government to provide mostly employment preparation-skills for trained labor, such as electronic, welding, culinary arts and office management, etc. Uwaifo (2010) stated that provision of vocational education is the focus of technical schools. It is in technical colleges that people are prepared to work in various jobs, such as a trade, a craft, or as a technician. According to Okoye, technical schools or colleges are post-secondary schools where vocational education is often provided. There are many government technical colleges in Nigeria according to the list of approved technical colleges in the country (NBTE, 2001). Six of such colleges are in Delta State.

Electronic work

One of the trades in technical colleges in Nigeria is electronic work (NBTE, 2001). In this trade, energy is required to withdraw an electron from a metal surface. According to Theraja (2013), this energy is a measure of how tightly a particular metal holds its electrons. This is a matter of how much lower the electron's energy is when present within the metal than when completely free. Electronic work is very important in applications involving electron emission from metals, as in photoelectric devices and cathode-ray tubes. Electronic work is practically oriented although there are many underlying theories that can aid students' understanding of the trade.

Theoretical Framework

Albert Bandura's Social Learning Theory

Albert Bandura was an influential social cognitive psychologist who propounded theories in social learning, concept of self-efficacy and Bobo doll experiments. In 1977, Bandura's theory stated that the learning process involved observing and experiencing new behaviors that are reinforced through other people or models. Bandura's work ranked almost equal with those of B.F. Skinner, Sigmund Freud and Jean Piaget. Bandura's social learning theory stressed the importance of observational learning, imitation and modeling. Bandura (1977) explained that learning would be exceedingly laborious, not to mention hazards, if people had to rely solely on the effects of their own actions to inform them what to do. In other words, the theory of Bandura shows an integration of continuous interaction between behavior cognitions and the environment.

Bandura's most famous experiment was on Bobo doll study in 1961. It centered on the making of a film in which an adult model was shown while beating up a Bobo doll and shouting aggressive words. The film was then shown to a group of children thereafter; the children were left and allowed to be in a room with Bobo doll. Amazingly the children who had seen the film with the violent model were prone to beating the doll, imitating the actions and words of the adults in the film clip.

The basic import of this theory is that learning can actually take place by imitating an observed behaviour and this is termed by Bandura (1977) as observational learning and characterized the elements of effective observational learning as attention, retention, reciprocation and motivation. Bandura's theory is a radical departure from behaviorism insistence that all behaviour is directed by reinforcement or rewards. It is observed in this theory that the children received no encouragement or incentives to beat up the doll but they only copied or imitated the observed behaviour.

This theory has a relationship with the present study onelectronic teaching/learning in technical colleges. Electronic repairs, experiments and practical project works can be effected or well done or learnt perfectly through imitating and observation by interested candidates who pay attention to the teachers or workshop attendants in practical classes with a few to giving attention and thereby resulting in retention, reciprocation and then motivation to learn and perform the work satisfactorily.

Jean Piaget's Theory of Cognitive Development

Piaget propounded a theory of cognitive development of 1936. The contributions of Piaget to education included theory of child cognitive development, detailed observational studies of cognition in children, and a series of simple but ingenious tests to reveal different cognitive abilities (Wadsworth, 2004). The goal of Piaget's theory explains the mechanism and processes by which the infant and then the child, develops into an individual who will be able to reason and think using hypotheses. The implication here is that cognitive development becomes a progressive organization of mental processes arising out of biological maturation and environmental experience. The theory shows that children can construct an understanding of the world around in other to experience discrepancies between what is already known and what is discovered in the environment. Wadsworth (2004) stated that Piaget's theory is not explicitly related to education. However, features of this theory applied in teaching and learning. Piaget's work has been extremely influential in developing educational policy and teaching. The issue of discovery learning that is based on the idea that children learn best through doing and actively exploring the environment is central to the transformation of primary school curriculum and seems to be relevant to this present study.

The emphasis here is on individual learning, flexibility in the curriculum, the centrality of play in learning, learning by discovery and the importance ofthe evaluation of students' progress where teachers should not assume that only what is measurable is valuable. Piaget's theory is based upon biological maturation and this connotes that readiness is important and it means that certain information or concepts should be taught when students have attained the appropriate stage of cognitive development.

This study can rely on this theory since learners are involved in the exercise of practice as active learners who can solve problems after discovery. This also shows the relevance of the theory to the study in that teachers should focus on the process of learning or performing a given task rather than the end product of it. Not only this, teachers are also expected to evaluate the level of students' assignments through adequate feedback.

Edward Thorndike’s Theory of Learning

Thorndike theory of learning was propounded in the late 19th century and it formed the basic principles of operant conditioning popularly referred to as Thorndike law of effect.The most famous work of Thorndike involved cats trying to navigate through various puzzle boxes. The experiment involves placing hungry cats into homemade boxes and then recording the time it took the cats to perform necessary actions to escape and receive food reward. Thorndike discovered that cats learnt after successive trials, from previous behaviour and as such the cats eliminated ineffective actions and escaped from the box more quickly. The observation here is that the cats seemed to learn, from an intricate trial and error process, which actions should be continued and which actions should be abandoned. This means that well-practiced cats could quickly remember and re-use actions that were successful in escaping to the food reward.Thorndike explained this as the law of effect which states that responses that produce a satisfying effect in a particular situation become more likely to occur again, while responses that produce a discomforting effect are less likely to be repeated.

The import of Thorndike’s work is at work in everyhuman behavior as well. This is so in so far as one learns from a young age those actions that are beneficial and those ones that are detrimental through similar trial and error process. This law is also very relevant to this present study since it involves behaviour modification. Essentially, if students do practical assignments that result into some useful products and are rewarded accordingly, students are definitely motivated to do that again and may likely do same again. Boundless (2014) stated that although this theory does not account for the entirety of human behaviour, it has been applied to nearly every sector of human life but particularly in education and psychology.

Theoretical Studies

This sectionhighlights the definition of technical and vocational education and training (TVET) as well as the following: use of assessment instrument on students' practical assignment, evaluation –principles and concepts, assessment procedure in electronicpractical, tasks in basic electronicpractice, importance of instrument to measure practical learning skills in electronics workshop practice and present assessment method of electronic workshop practice.

Issues on technical vocational education and training (TVET)

Vocational education is the type of education or training which prepares trainees or individuals for jobs or works that are based on manual or practical activities. Before now, it was traditionally nonacademic and totally related to a specific trade, occupation or vocation. It is often called vocational technical education and training education because its recipients directly develop expertise in a particular group of techniques or technology (Olaitan, 1996). In other words, this type of education has its focus on specific trades such as automobile, mechanic, welding, electrical fitting and installation, electronic, etc,. This underscores the importance of technical vocational education and training in all over the world.

Use of Assessment Instrument on Students' Practical Assignment

Students' practical assignment or assessment involves skill-centered activities. Such assignment are objective in nature and should follow a particular sequence of procedure which should be carried out to a certain level of competency before an end product or result that will meet certain criteria is created. To achieve all these, the use of assessment instrument is called for, and this can be achieved through observations.

Assessment has been defined by Nkwocha (2004) as the use of different instruments, strategies and sources to gather and record information about how many individual learners have developed in the three domains of learning at specific intervals while still under training.The whole idea here is that a vocational and technical teacher who wants to determine whether a student has achieved a desired skill or not will need to look at the process the student employed before the final product, in other words the assessment instrument will help to determine whether the correct process has been used while American Association for Vocational Instructional Material (2000) submitted that it is far better to even grade the final product in other to determine whether the student has learnt a particular skill.

The above simply depicts that assessment instrument (like tools) are materials that enable the collection of evidence using a chosen assessment method (Government of Western Australia, 2016). The report of the Government of Western Australia (GWA) also shows assessment tools as the instruments and procedures used to gather and interpret evidence of competence. The instrument in this context is the activity or specific question used to assess competence by the assessment method selected. This may be supported by a profile of acceptable performance and the decision-making rules or guidelines to be used by the assessors. Procedures here mean the information on instructions given to the students and the assessor about how the assessment will be conducted and graded.

The idea here is that objective assessment rather than any other thing is desired on the performance of students. As Tavakol (2014) put it that it is not always the case that what the students produced will be easy to assess using physical measurement, although in other situations, according to Okwelle (2014), the students' work might really involve some tasks to achieve a finished product, for instance, in some industrial arts projects. With this kind of situation which is peculiar to vocational/technical subjects, it therefore means that a number of factors must be considered in other to fairly assess the overall quality of the product. In line with this reasoning, one method, according to GWA, that is very useful in determining practical performances of students is centered on the use of rating scale.

Observation is an important method for competency based assessment and it requires candidates or students to demonstrate not only what they know, but what they can do. This is what is referred to as practical performance.This practical performance has turned out to be an effective means of assessing students learning outcomes in technical and vocational education and training (TVET). Accordingly, GWA stated that the use of observation as a method of assessment in this regard enables one to see or examine directly what students can do. And a number of tools can be developed to support such assessment method and this includes: observation, checklists, questions to accompany checklists and instructions to candidates and observers/assessors.

Reviewing the work of Wolansky (1985) and comparing it with that of GWA (2016), it can be found that an observation checklist is useful when observing performance in both real-work situation or in simulated environment where candidates are able to demonstrate vocational skills, employability skills and application of work place procedures.An important provision here is that clear instruction for the students and for the assessor should be provided in the checklist. In other words, students need to know exactly what is expected of them, and any materials that they are expected to supply while the assessors also need to know exactly what to look for, what resources are needed and any other issues that need consideration, like the knowledge of the use of the observation list.

It is also very important to state here that the use of process and product testing methods are also used in testing vocational and technical subjects. The only thing is that for effective process assessment, a teacher needs to be at alert and consistent in observing the students' work and the process will have to be assessed objectively by using a checklist.

Checklists according to Nitko (2001) are the least complex form of scoring system and are appropriate when the teacher/assessor is looking for the presence of specific elements in the product or performance, and all elements are generally weighted the same. Nitko put it that the teacher marks or checks each occurring element against the prepared checklist. Then, the score will be the total number of items that are checked. It is also stated that no extra score is awarded for doing one of the elements twice or multiple times except the checklist specifies the number of times something must be done.

The second form of assessment is the rating scale. It offers ways to attach quality to various elements of the process or product. For example, it is very common for someone to rate something from 1 to 10 being highest score.

Consequent upon the above, checklist and rating scales are a good means of assessing the process used and the products made by students. The only critical issue is that well-constructed checklist and rating scales should contain clearly defined criteria for assessing students' performance American Association for Vocational Instructional Materials (2000) as cited in Chiejile (2006) observed that these criteria would help the assessor to focus observation on the salient aspect of objectives and to ensure that those observations are objective enough. At this juncture, it is imperative to state that process assessment is okay to ensure that a student can use tools and equipment in the correct way and there is also a need to take the time of completion of the process into consideration. In addition, whenever health and safety risks are involved as well as the inability to assess the final product without destroying the work, then process assessment will be imperative.

Writing more on a rating scale, Okwudili (2014) submitted that it helps an assessor to discriminate between groups of students when looking at the products in terms of process that is being followed. Although as can be noted in this literature review, checklist and rating scales are so important in process and product- oriented assessment, there could also be some short falls of the use of this kind of subjective methods. It is therefore important that constructed rating scales should be supported by explicit instructions on what quantities to look for in other to have a higher reliability.In another argument, Bowles (2003) submitted that reliability is not that guaranteed when judging individual differences in students' performance, and some of the reasons for this unreliability could be that students show small individual differences in the selection of a task to be assessed, inadequate instruction to the rater, poorly designed instrument and lack of adequate training in using such assessment instruments.

Consequent upon the above, it means that reliability and objectivity can only be got with careful administration of manipulative skill test. Towards this, students need to know the areas of task that would be rated so that appropriate attention is given to it. Therefore, the achievement of this will be based on: enough preparation of the work area, provision of students with needed tools, materials and equipment for the assignment, giving students information about every point that needs to be rated, provision of the same working conditions for all students and not helping or assisting students in the test process. Other salient factors are: provision of adequate instruction for students to follow and to ensure that they understand clearly what to do and the time at their disposal to complete the whole test; and preparation of checklist that does not entail long writing in other to allow for time to really observe students' performance during the test. It is also important that the rater should be familiar with items on the checklist before the test administration (Bowle, 2003).

As observed by Anta (2005), application of clearly defined criteria in a test will help the students and the teachers to get reliable objective and accurate result of the assessment process. It is therefore very important that those involved in the test should use critical observation in applying criteria and tolerances stipulated in the project plan. It is the hope of this study to pay attention to this area of literature review because it has a direct bearing on the mode of construction and administration of the instrument that would come up later.

Nworgu (2006) quoting defined evaluation as a means of determining the extent to which educational objectives are being realized. According to World Bank Institute (2007), evaluation from education viewpoint is the process of finding out how well educational goals are being achieved.Thissimply means that the sole aim of educational program evaluation is improvement.

As it is, the main purpose of a program evaluation can be to determine itsquality by formulatinga judgement(Marthe,2009). Reeve and Paperboy (2007) viewed evaluation as methodologically diverse and is in line with the opinion of Okwelle. To them evaluation from the instructional point of view is a systematic method of determining the extent to which instructional objectives have been achieved by pupils. Here method may be qualitative or quantitative and includes case studies, survey research, statistical analysis, model building and many more, such as assessment action research, axiom design, cohort study, electronics portfolio, focus group, grading, inquiry, observational techniques, process improvement, sampling statistics, and so on.

As stated here, the ‘quantitativeness’ entails measurement and ‘qualitativeness’ shows its dealing with non-measurements. There are four main targets of proper use of evaluation. These are to: clarify the intended learning outcomes, provide short terms goals to work, offer feedback about learning programs and to provide information for overcoming learningdifficulties and to select future learning experiences (Okoye, 2015).

Indigenous scholars like Okoro (1996) and Olaitan (1996) also indicated evaluation as a process that involves passing judgments on the adequacy of the scores or marks obtained though measurement. These authors discussed the functions of evaluation in education as the determinants of students’ understanding of the contents of what is being taught; as the provider of feedback to students as regards their academic progress; as the assistance to help teachers to know students who need special attention and as a helper in assessing teachers’ effectiveness. Other function of evaluation include enabling teachers to offer educational and vocational guidance services to students and to enable teachers to supply the needed information in program evaluation and curriculum development and lastly to help the teachers.

Evaluation – Principles and Concepts

The idea of placing value on certain things as regards their goodness or badness' appropriate or inappropriate, desirable or undesirable, is evaluation.At one time or the other, man must place value on objects, performances, processes, decisions, and situations, etc. In a write up, Okoye (2015) stated that the general concept of evaluation centers on making decisions and judgments by individuals, groups, government and other institutions on issues or things affecting lives. Such decision –making, especially in education, involves gathering and analysing relevant information and data.

In life, going to the next stage entails some kind of examination in other to make a sound judgment as regards who proceed to the other level. This is a process that gives rise to a grading system where students are classified frequently, termly or yearly. Thus, as stated by Okorie (2010), examinations as well as other evaluation procedures are used to make critical and other important decisions about the worth of a student and his career especially in the educational system.

Although, there are many definitions of educational evaluation, it is perceived by Aworanti (2016) as a process which involves a systematic and scientific methodology, identification and provision of information, selection of criteria, analysis of data and then making logical conclusions for particular objectives.Literatureavailable on evaluation according to Yoloye, (1971), Bloom (1964) and Okoro (1996) as cited in Okwelle and Chiejile (2006) illustrate the meaning of evaluation inaccordance with the perception of six blind men of Hindustan who described an elephant according to their exploration of the different parts of the animal. The elephant was actually what each described and a lot more, and this concept is so for evaluation. The keynote here is to actually define evaluation in operational terms.

In another parlance, evaluation is seen as the systemic collection of evidence to find out whether some changes have taken place in the students and to also determine the extent of such changes in individuals.Here the process is not analysed but the point of concern is with changes taking place in the learner in other to have a desired behaviour. This addresses the goal of evaluation to determine whether students have got the necessary knowledge and skills to graduate from the program or / and enter the world of work.

According to experts (already mentioned) there are three types of evaluation used commonly in education. There are formative, summative and ultimate evaluations.Formative evaluation is employed in monitoring the progress of learning when instruction is ongoing while summative evaluation is carried out at the end of instruction.Ultimateevaluation is working inplaces or organizations after the completion of program of study by students with subsequent gain of employment in a chosen occupation. Both formative and summative evaluation is to be used in this study which involves process assessment of students' practical skills in electronics technology. No doubt, educational evaluation involves the use of assessment in teaching/learning situation. Therefore, the concept of evaluation is very relevant to any program where there is a step by step process of assessing the appropriateness or otherwise of an organized course of study.

The sole aim is really to use the process to ascertain the extent of the achievement of the objectives of such programs. This will then lead to a good decision making in terms of administration. As stated before there are many definitions of evaluation, but one thing is certain, and it is that it is an important factor and is widely consulted in all activities involving teaching and learning.

Reliability in instrument for assessing students' practical performance in Colleges

Anotherimportant but measurable psychometric property of an instrument is its reliability. Instrument Development and Validation Scientific standards version 2.0 (2013) gave a guideline that the reliability of an instrument should be described, including the methods used to collect data and estimate reliability. This is important in providing rationale to support the design of the study and the interval between first and subsequent administration to support assumption that the population is stable. In line with this therefore reliability, can be described as the degree to which a particular test or instrument yields consistent or faithful measures of anything it measures when used again and again.

In other words, reliability deals with the extent to which a measure is repeatable or stable. Essentially, reliability refers to the consistency of a measure. Any reliable measure would return the same results from time to time, assuming the underlying phenomenon has not changed. Reliability is of particular importance because it establishes a ceiling for validity.

Methods of establishing reliability in instrument

Methods of establishing reliability include:

1. **Test re-tests (measure of stability)**: The reliability here is determined by administering at time 1, and the after some period of time it is administrated again at time 2. A reliable measure would produce similar results at both points in time.
2. **Parallel forms**: This is also similar to test – retest reliability and it consists two versions of the measure and one version is administrated at time T, while the second version is administrated at time T2. The advantage of this method is that the problems of memory associated with test- retest method of examining reliability are corrected in parallel forms because individuals have not seen the version 2 items previously. The only difficulty of this method is that it requires developing a considerable number of items that measure the same thing.
3. **Internal consistency**: This method of establishing reliability essentially relies on how well the several items within the measure hang together; imagine that a measure of students' learning satisfaction contains ten statements regarding how satisfied the students are with the teaching, class environment, etc. Basically, the reliability of the measure is examined by estimating how well the items produce similar results.
4. **Inter-rater reliability**: In this type of reliability there are multiple judges or raters evaluating the same phenomenon. It is essentially the extent of consensus among the raters. A high degree of consensus would be evidence of inter- rate reliability.

This present study employed internal consistency using Cronbach alpha co-efficient to establish reliability. According to Tavakol (2014) it is a statistic tool generally used as a measure of internal consistency or reliability and it was developed in 1951 by Lee Cronbach to provide a measure of internal consistency of a test or scale and it is expressed as a number between 0 and 1.

The main reasons for the use of Cronbach alpha are simply that the questionnaire items are going to be rated based on degrees of appropriateness or suitability and the items that will be generated will be objective test items. Related instruments by Tavakol (2014), Green and Thompson (2005) andGarba (1993) employed Cronbach alpha ( ) co-efficient to establish reliability.

It is however very important to note that improper use of alpha can lead to situation in which either a test or scale is wrongly discarded or the test is criticized for not generating trust –worthy results. This is what was reported by Chiejile (2006)who cited Nwagu (1985) as saying that reliability sometimes may not be easily achieved based on some factors including changes within the individual sequel to learning effect, memory degeneration or physical and cognitive development as well as the disposition of the scores.

However, internal consistency is necessary but not sufficient condition for measuring homogeneity or unidimensionality in a sample of test items. This simply means that it is possible to have a test which provides consistent results without it providing valid information concerning the behaviour that is being measured. Contrarily, highly consistent test results may be measuring the wrong thing or may be used improperly. To avoid this situation, Tavokol stated that an understanding of the associated concepts of internal consistency, homogeneity or unidimensionality could help to improve the use of alpha. This report suggested that test scores cannot simply be interpreted as an index for the internal consistency of a test.

Along this line, the development of the instrument here is not expected to be perfect in getting consistent result. This is because as emphasized by some scholars (already quoted), factors other than the quality being measured might influence test scores. For instance, administering a test on the same group in close succession twice could result to some variation due to temporary changes in memory, attention, fatigue, personal effort, emotional stress, guessing and other related factors.

Customarily, a high correlation based reliability co-efficient of about 0.80 to 0.90 is normal for norm referenced assessment/evaluation. Chiejile submitted that reliability estimates could be reported separately for some subsets in criterion referenced test. Consequently, the reliability coefficients can be anticipated to be lower with a more limited number of items. Okwelle discussed that the extent of the presence of error in the test items under different condition is a measure of reliability. Thus as succinctly put by Mkpa (1992), the more consistent test results are from one measurement to another, the less error in it and the better and greater the reliability.

Among the useful guidelines given for the development of instruments for assessing practical performance is usability. Other guidelines include shortness to avoid boredom, easy usage in terms of administration and scoring and less cost in production. These are the features and psychometric property of non-cognitive test items. The implication here as stated by Gbosi (2004), is that usability has to do with practicability. It should be stated that an instrument may be useable but it is important to note that every rating techniques are prone to some error which can actually lessen the validity and reliability of the instrument.

Other factors which can result to elements of bias in scoring or rating performance include but not limited to the following:

1. Error of generosity: This is where high ratings are given than are necessary.

2.**Severity error**: This occurs when individuals are rated lowly on all characteristics.

3. Error of central tendency: This is with reference to being on neither sides of the extreme but instead having a cluster at the middle.

4**. Halo effect**: This occurs when a generalized impression of the rater influences the rating that is given on every aspect of the behavior or performance.

Possible methods of combating or reducing these errors in the process of rating are put forward here:

1. The rater should be informed of the possibility of committing this kind of error as well as its consequences.
2. Adequate time is needed to observe the raters before the rating exercise.
3. There is the need to clearly define the behaviour to be rated and the points on the rating scale.
4. Provision of verbal and or written guidelines to the raters on how to use the instrument prior to the rating is necessary.

From the above submission, usability becomes the most important psychometric property of an assessment instrument since it is the most practicable aspect of the instrument. Based on this, this study will go after the process of making the instrument usable with due regard to its administration, scoring and interpretation of test data. This is intended to be achieved by ensuring that errors highlighted above are minimized to the barest level through the taking of far reaching precaution such as familiarizing the raters with the use of electronic work test instrument (EWTI). The technique here will be to give the EWTI to the raters who are then educated and instructed on how to use the instrument and thereby making it practically useful.

Okoro (2005) and Okwelle observed that the appropriate reliability to use is the scorer /rater reliability to determine the relationship degree among raters when the scoring of learning outcomes involves the use of rating scales and observation schedule. Therefore, for this study, the relationship among the raters will be determined by trying out the EWTI and later applying the intra-class correlational technique.

Assessment Procedure in Electronic Practical

Technical education in the past stood as a major part of informal education system in Nigeria. This view was also supported by Fafunwa (1974) who explained that vocational technical education was taught through the apprenticeship method where it was easy to determine the performance of learners in technical skills. The system entailed teaching them to observe whatever skill that was demonstrated by the 'oga' or a master craftsman.

Those days, teaching/learning of the craft started with a kind of personal service to a master where young boys ultimately became house maid/servants to those craft masters. And in due course, these servants were gradually pushed into learning the craft from the master. Thereafter, after some years of maturity and on the job, the teacher would watch or supervise the servants carry out similar skills or jobs. This was the major practice then and clearly defined technical education as important aspect of education in Nigeria especially in the pre-independence times and until the 20th century (Uwadiae, 1988).

However, in the recent time, there is a formal education system where technical subjects such as electronics work, radio and television, bricklaying and concreting, carpentry, fabrication and welding, vehicle body building, woodwork and other skills subjects have been introduced to technical schools and colleges through technical Institutes like Blaize Memorial Industrial School, Abeokuta, and Hope Waddel Training institute, Calabar, and for the now, there are other technical institutes like Federal Metallurgical Training Institute, Onitsha in Anambra State, Petroleum Training Institute,Effurun, Warri in Delta State and other technical schools scattered all over the Federation. All these started as early as 1960s and progress along this line continues till date. The only challenge had been on the mode of assessing these practical subjects especially electronicpractical. Earlier, all of Nduka (1964), Okorie (1988) and Eteng (1980) remarked that subjects such as agricultural science, and by extension,electronicstechnology that are practically oriented are bedeviled with inadequate assessment.

Consequently, electronic technology students in technical colleges and schools perform poorly in electronics practical when they were actually expected to do well on such skills’ involving tasks.Studentstherefore had a good cause to complain since the grades assigned to them failed to reflect the quality of workmanship.Likewise, many of the scores awarded are poorly justified in terms of performance. As at today,people still take and pass National Business and Technical Examination Board (NABTEB) electronics in flying colors yet there is no evidence that they have actually acquired the required skills of the occupation.

The aim of teaching electronic technology in technical colleges should not only be to excel in NTC –NABTEB examination but also to show case the essence of teaching/learning vocational and technical education subjects (including electronic) with due respect to the use of knowledge and skills which have been provided in the learning process. According to Aworanti (2016), there is the need to prepare persons for the world of employment through well assessed practical examination in trade areas. This means that emphasis is on practical performance and as stated by Olaitan, instruction would not be complete except the student used the skill or ability being taught. Aworanti (2016), just like Wentling and Lawson (1975) emphasised that learner performance- based test is the most useful among all measuring techniques used in occupational education like electronicpractical.

This performance –based test or assessment is key in the psychomotor domain. Bukar (2006) had already stated that observation of students’ performance in teaching/learning of an individual in workshop practice would remain the best way to measure the person’s capability and this should match the scores obtained. And synchronizing assessment with objectives, Ofulue (2000) and Okwelle recommended that students’ learning outcomes in electronic workshop assessment should be predicated upon performance and should be graded with an instrument that is valid and reliable.

Tasks in ElectronicPractice

Students who are interested in taking courses inelectronic work offer its subjects at both intermediate and advance levels in the states and federal technical colleges. Common subjects include troubleshooting, installation and repair. The study of basic electronic technology teaches students how to diagnose, repair, design and create electronic components. National Coalition for Electronics Education (NCEE) (2016) submitted that students are prepared for work with lasers, fiber optics, robotics and computer technology through classroom lectures and hands –on experience (practical performance). It also stated that within basic electronic course, students are expected to go over to: career option for electronic professionals, connections between electronicand engineering, significant trends in electronics industry, professional certification and even major technical concepts and troubleshooting.

The curriculum of basic electronicin addition to general education subjects like English Language, General Mathematics, Chemistry, Physics, Social Studies, etc., has core trade subjects which include Technical drawing, Basic electricity, and communication cable joining (soldering) and semi conductor devices as well as troubleshooting. Basic electronic is sometimes broken into two separate courses depending on the programme.Studentsstudy direct current (DC) and amplitude changing (AC) circuits, especially in relation to resistors, capacitors, inductors, voltage and harmonics. Through the design, creation and testing of these circuits, students are able to learn laboratory or workshop procedures, troubleshooting techniques, safety and tools. Other list of course in basic electronic include: microprocessor course, electronic mathematics course, computer installation and repair course.

In Nigeria, at the end of the program, students then register to take one or more or all of the technical certificate examinations which are NABTEB Trade Test I, II and III and Federal Craft Certificate Examination. Although NABTEB examinations in basic electronic contain both written and practical tests except in English Language, Social Studies and Mathematics, basic electricity courses are really designed to prepare students to understand the workings of equipment such as amplifiers,transistors,transducers and fiber optics. However, candidates are expected to pass the written subjects as well as the practical test in other to be certificated.

Electronic, as recommended by NCEE, must teach certain concepts and skills which require hands –on and classroom training in basic electronic, appliance service and electronic systems. Possible careers with the mastery of the program after certification include aircraft technician, sound and broadcast engineer, telecommunication equipment installer and repair.

To achieve the above, Aina (2000) stated that training materials (instructional) and skills must be utilized in the course of instruction and such must be suitable and commonly available so that communicating the concept of technology correctly and practically will be easy. Electronic teacher, therefore, has to carry out the responsibility of sensitizing and stimulating learning process with the aid of equipment, tools as well as instructional materials.

As stated before, basic electronic practice or tasks in technical college curriculum involve some skills that are necessary to get given tasks or jobs done in fault diagnosis, troubleshooting, maintenance of equipment, assembling of components, and servicing generally. It also involves testing of finished jobs. It is imperative that students do these tasks with the aid of tools and necessary equipment and at the same time, the rater should assess their activities with reference to some valid test items intended to be developed and called electronic work test instrument (EWTI).

Importance of Instrument to Measure Practical Learning Skills in Electronic Workshop Practice

Electronic workshop practice is a unit of electronic work which is intended to give guidance on the safe use of electronic workshop facilities to ensure that technical staff, other staff and students will not be harmed by any of the processes, materials or tools in day –to – day operations (James, 2016). However, the extent of students' performance in this subject is dependent upon how it is assessed at the end of the learning session or during examination. In other words, there has to be an instrument that should be able to measure students' abilities not only in the cognitive and affective domains but also in the practical skills (i.e. psychomotor domain). James posited that little has been done to develop instruments that measure outcomes in psychomotor domain in some trade areas while nothing concrete seemed to have been done in the area of electronic workshop practice.

Akinseinde (2016) gave some reasons for this by stating that it is time consuming to prepare and administer tests to assess manipulative skill that is geared towards measuring and analysing students' skills when they do selected operations especially under rigidly controlled condition. Okoye (2015) also lent credence to this by stating that such tests tend to limit the number of students that can undergo the test at the same time.

Accordingly, it should be noted evidently that practical skill tests had been in existence for a very long period of time even though informally. Fafunwa (1974) called it the traditional education in practice then. As succinctly put by Chapman (2016), it was mostly practical, non-verbal and informal. This means that it existed as an apprenticeship system where the apprentice was allowed to understudy/watch the master craftsman and he was then assessed by him to find out the extent of his learning for possible correction wherever necessary.

The above only shows that practical skill assessments are very old but the gap is lack of emphasis on non-cognitive learning outcomes in today's educational system in the third world countries especially Nigeria. Dike (2009) said that the consequence of lack of emphasis on the non-cognitive learning outcomes gave rise to the neglect of manipulative skills, attitude and values in Nigeria's educational system.

The need for non-cognitive evaluation was also emphasized by Ulasi (2010) when he criticized the almighty summative evaluation system where assessment is mostly centered on the knowledge aspect of learning process to the detriment of the student's skill assessment in connection with their character and industry. As stated by Chapman (2016), practical skills relate to the application of knowledge, theory and/or skills students have developed in (higher) education to complete real life tasks. This is also in line with the position of Mkpa (1992) in Chiejile, Okwelle and Akinseinde who stated that practical skills are those skill or special abilities required by the learner in human activities and which can be acquired through learning and constant practice.

The deduction here is that cognitive or affective assessment cannot bring about all the desired learning outcomes. Therefore, it is important to assess student's ability in the performance of manipulative skills. This is the only type of evaluation that lends itself well to the use of rating scales. It is these scales that would enable the assessor to rate student's abilities and performances adequately well when well developed and validated.This study discovers that a paper-pencil test is many times, less adequate in determining mastery of practical skill, and therefore it follows that practical or manipulative skill test will no doubt lead to a better and more comprehensive student's assessment where results of instruction in real life application are felt and students would be able to analyse their own strengths and weaknesses.

From the foregoing, it is not difficult to see the gap existing between summative evaluation of learning outcomes and that of non-cognitive learning. The worry is that this gap continues to widen by the day. It could even be a result of this that made the new National Policy on Education (FRN, 2012) to recommend the continuous assessment method in the country's school system. The aim here is simply to correct the imbalance existing between cognitive and non-cognitive learning outcomes through comprehensive testing. The evaluation being advocated here is such that will stimulate real life situations so that results will show true abilities of students. Chapman (2016) put it that learners should be able to perform skilled operations taught to them under conditions that are equivalent or replica to the working condition of the trade; these are the requirements of test performance.

It is therefore very necessary to have a solid basis upon which process and product assessment can be carried out; as Watt (2013) said, an availability of ready instrument for assessing manipulative skills is a sine-qua-none. Corroborating this issue, Nzeife (2010) in a study wrote that teachers should be attentive and consistent in observing student's performance during process assessment and this should be objectively done by employing performance checklist. However, such checklists should be developed in relation with performance objectives and student's activities. Chiejile opined that in product assessment, every instructor must objectively judge the quality of the finished product.

In conclusion, the importance of instrument in ensuring proper assessment of all essential or manipulative skills in most technical and vocational areas (electronic practice inclusive) cannot be over-emphasised. It is therefore very important to have one in place.

Present Assessment Method of ElectronicWorkshop Practice

Teaching and learning process (education) involves the provision of evidence of success of the individual students through the assessment of practical performance especially in psychomotor trades like electronic workshop practice. It also involves givingfeedback to the learner. Oji (2011) wrote that feedback is a kind (or form) of motivation which stimulates learner and encourages good act of teaching.

In electronic education, students' grades are predicated on the ability to plan the exercise, attitude and ability to work in co-operation with others and upon the knowledge of related information (Igwe, 2014). Evaluation of practical skills through the use of paper –and- pencil test or the use of oral interview has been widely condemned by researchers (Okoye (2015), Ezeji (1996) and Okoro (2005).Evidence from their studies shows that there are aptitudes to be tested in students and pencil- and – paper tests are not usually valid predictors of practical performance.

Related Empirical Studies

There have been some development and validationof assessment or evaluation instruments in the non-cognitive and psychomotor domains by few researchers. A review of such studies is the focus of this section of the study. Okoro (1991), in a study, evaluated the service techniques of radio/television repairers in the Eastern states of Nigeria. The study was purposefully to observe the repairmen while dealing with customers and while effecting repairs on the electronics sets or gadgets brought for such. Not only this, the study aimed at rating the radio/television repairmen on the tasks or activities engaged in by the electricians and also find out the major problems that adversely affected the performance of the electronics repairmen.

The study (Okoro,1991) gathered its data using direct observation and the instrument developed. The number of repairmen that constituted the sample of the study totaled 180. A five- point – Likert scale was used for the rating with five standing for excellent procedure and a rating of one represented a very inadequate procedure or state of affair. Ten factors concerning repairmen's servicing techniques of radio/television sets were investigated and a mean score was got for each of the factors Interview was used to identify the challenges affecting their work.

Results of the study showed that repairmen failed to be patient in listening to customers' complaints on their bad electronic sets. It was also reported that repairmen were very reluctant to tell the customers the true conditions of their defective electronic sets. Other two results of the study centered on the careless attitude of the repairmen in handling electronic sets and also the customers seemed not to have enough confidence in the ability and sincerity of the repairmen.

It was found out in the study that nine out of 10 factors that constituted major obstacles to their professional success were identified by the repairers. These factors were said to include poor theoretical knowledge, inadequate skills and techniques, insufficient testing instruments and tools, lack of funds and spare parts, unfriendly work environment and inability to win the confidence of customers.

As it were, this study has its educational implications. And these included that practical courses could be complemented well with theoretical courses in trade centers, technical colleges, polytechnics, college of technology where the repairmen could be trained to acquire high skills in other to be able to repair all kinds of electronics testing and measuring equipment without being limited to radio, television and audio sets repair. Another implication was that government would need to encourage repairmen through the provision of loan facilities to assist them in the work. In fact,Okoro took a note of the establishment of Peoples' Bank of Nigeria in order to arrest this situation among the entrepreneurs.

The review of Okoro (1991) study is directly related to this current one. This is because Okoro employed the observation method to assess/evaluate the service methods of the radio/television repairmen and this would also be engaged in rating the students in their performance in electronics workshop. It should be noted that there is a great emphasis on the observation of students during performance of tasks in the workshops. This is so in order to identify areas of strength and weaknesses in readiness for making final evaluation decision on the projects.

In another study conducted by Bukar (1994), an instrument for evaluating practical projects in electronic(IEPPE) at the NCE (Technical) level in Northern states was developed. This instrument contained 68 items and was validated by six lecturers in Industrial Technical Education and two skilled technicians in electronics. It was further validated by six other lecturers teaching electronics technology in other higher institutions.

Bukar then developed five stages of project production after reviewing literature. These stages are: designing, planning, execution, assembling and testing. The data for the study were collected from 65 electronic lecturers in the NCE (Technical) awarding institutions in Northern Nigeria. Statistical methods of frequency count mean and standard deviations were employed for data analysis. Cronbach-Alpha formula was then used to determine the reliability coefficient of the instrument. This was then 0.88.

Bukar's study gave a result that indicated that the IEPPE items were valid and reliable for electronic technology project evaluation. The result also showed that, after data analysis, the instrument instilled confidence in students and the teacher with regards to evaluation process of practical electronic projects. It also reduced inefficiency on the side of the evaluators while his study concluded that results got would go a long way to dispel doubts and skepticisms of students about evaluation techniques that teachers used to assess their practical projects. Bukar finally recommended that similar instrument be developed in other areas of industrial education at NCE (Technical) level with some expansion in scope so as to cover all NCE (Technical) awarding schools in the whole country and not just in one region.

Despite the fact that Bukar's instrument that was developed to assess practical projects in electronic even had a high reliability coefficient of 0.88, its reliability and userability (workability), after preliminary validation, was not tested on any set of student's project for certainty. This implies that his study had a limit to more developmental stage. The challenge posed by Bukar's work in relation to this study is that any developed and validated instrument for assessing electronic practice should be tested on any set of student's projects to ascertain further its reliability and workability. As such, this study intends to develop, validate and test-out a process assessment instrument for assessing student's practical performance inelectronic within the technical college in Delta State of Nigeria.

On the other hand, Chiejile (2006) conducted a study on the development and validation of a test instrument for assessing student's practical performance in electrical installations. As the study implies, it employed instrumentation design in its research approach. The area of this study covered Edo and Delta States because of the existence of many technical colleges and other educational similarities. The study did not sample the population because of the fewness of the number (57) in persons of technical teachers, with minimum qualification of B.Sc (Technical Education) in Electrical Technology, HND Electrical Technology plus Post Graduate Diploma in Education (PGDE) and

FullTechnology Certificate (FTC) in Education Technology plus Technical Teacher's Certificate (TTC).

After a thorough literature review, the researcher developed the instrument in 10 stages thus: identification of practical skill areas in NTC electrical installations curriculum, development of test items, development of rating scales for assessing practical performance, synthesizing of test items, preliminary selection of test items, try-out of instrument, reconsideration of test items, validation of instrument, testing for reliability of instrument by technical teachers and then final selection of test items. Following the procedures in these stages, a draft instrument was then tried out for its workability on 30 students who were final year students in electrical installations and they were randomly selected in the pilot study.

They were observed directly and rated by trained raters while the researcher supervised. At the end, the study utilized Cronbach- Alpha coefficient to analyse the data collected and a reliability of 0.89 was found. The instrument was therefore said to be reliable for the study and based on the raters' comments, some items were reconsidered.

Chiejile's study or work utilized both face and content validity which were done by four lecturers in Vocational and Adult Education Department, Faculty of Education, Nnamdi Azikiwe University, Awka and two other Lecturers from the Department of Technical Education, Delta State University, Abraka. Also a test-retest method was used to test for the reliability of the instrument. The researcher administered the instrument under practical examination condition to 24 final year students of electrical installations who were selected randomly from Federal Science and Technical College Awka in Anambra State. The study reported that after a period of two weeks, the same instrument was administered on the same group of students and it was found that the reliability of the instrument using Pearson-Product Moment Correlation Coefficient was 0.79 showing how reliable the instrument was.

The researcher later administered the instrument on 253 respondents and analysed the data collected using mean and grand mean to describe the mean ratings of test items and tasks respectively. Some of the findings of this work arising from data analysis included: that seven electrical installation tasks were included in the instrument; that the instrument possessed a high face and content validity; that the reliability of the instruction determined by Cronbach-Alpha revealed that reliability for the eight electrical installations tasks ranged from 0.86 to 0.97. The reliability for the whole instrument was 0.93. And this indicated that the instrument was highly reliable.

The findings also showed that there was no significant difference in the mean ratings of B.Sc, HND and FTC teachers in many of the rated tasks. This indicated that there was no discrimination in their ratings. Also, as regards the test items to be included in the instrument, the findings showed no significant difference in the mean ratings of the B.Sc, HND and FTC teachers.

The implication of Chiejile's work is that the NABTEB curriculum planners should place emphasis on practical skills rather than knowledge as this will provide the necessary entry requirements to the students in electrical installations. Furthermore, the study implied that there should be a de-emphasis on theory (knowledge) when assessment techniques are formulated for electrical installations students in technical schools.

Finally, the work was limited to the area of electrical installations while it suggested that further research should be carried out in developing and validating an instrument that could be used in assessing students’ practical performance in Radio/Television in Technical Colleges.This is the hope of this present study aimed at developing and validating an instrument to be used in assessing student's practical performance in electronic work.

Okwelle and Okeke (2011) also carried out a study in the development and validation of instrument for assessing practical skills in fault diagnosis and repairs of radio and television systems in Nigerian technical colleges.Part of the study’s review of literature according to Mansell (2002) revealed that a simplistic measure of quality of teaching would be how effectively and efficiently students could, at the end of a course or program of study apply or use the skills that had been learnt. Okwelle and Okeke described practical skills as organized and coordinated forms of physically observable activities exhibited in the process of carrying tasks in vocational and technical education and other related fields. He quoted Khan (2007) who said that performance tests required students to perform a task instead of answering questions. Khan regardedthis method of examination as the most credible tool for assessing practical skills as it affords students to demonstrate practical skills and operations taught to them under conditions that are similar to the working conditions of the trade (Ali,1990).

Radio and television trade curriculum among others is aimed at training skilled technical manpower equipped with the necessary technical knowledge and practical skills for diagnosing and repairing faults in radio and television systems. The review of Okwelle's study indicates that these tasks are to be carried out by students step by step before arriving at the final stage of accomplishing the job. The implication is that each step and the final stage or finished product should be comprehensively assessed and systematically too, by the teacher in other to achieve the objective of the training.

However, evidence from research studies (Bukar, 2006, Chiejile, 2006, Garba, 1993 and Okwelle, 2014) reveal that only final products are merely looked at without paying attention to the process that is actually involved in carrying out this practical work. The issue here again is that such awarded grades basely merely on observation is considered biased and does nothing to show the real ability and feelings of the students. Chiejile (2006) said a reason for this lopsided method of assessment by the teachers could be that they are too busy or reluctant to assess the various stages of individual student'swork due to non- preparation of a definite procedure of assessment. He further stated that although NABTEB uses a marking checklist to assess students' practical in components of NTC examinations, the challenge of the scheme is that it merely highlights the major skills to be rated, it lacks details of the various stages of specific skills involved in the process of doing the tasks. The implication of his study reveals that the scores and grades given to students in practical works by the teacher failto be a true representative of their actual performance.

Consequent upon the above plus the bid to improve the assessment standard in technical and vocational education and training, there is that pressureto use valid and reliable instruments that can take account of the process of practical activities that eventually result in the final products. Although Bukar (1994, 2006,), Chiejile(2006), Garba (1993),Okeke (1998), and Yalams(2005) developed instruments in this regard, literature available to the researcher shows that no such instrument has been developed and validated for use in assessing practical skills in radio and television trade in Nigerian technical colleges. It was against this background of paucity of standard instrument for assessing practical skills in radio and television trade that prompted his study (Okwelle). The study actually attempted to identify appropriate practical skills for inclusion in a radio and television skill assessment scale (RTSAS) instrument for use in technical colleges. The study also sought to ascertain if there were differences among technical teachers on their ratings of appropriate technical skills for inclusion in RTSAS based on their qualifications and length of years of experience. The study was guided by four research questions and two null hypotheses. It was an instrumentation research designed to be used because of the introduction of new procedures, technologies or instrument for educational practices (Watt, 2013). The area of the study was south – south zone of Nigeria comprising of AkwaIbom, Bayelsa, Cross Rivers, Delta, Edo and Rivers States.

The population of the study targeted two groups of people; i.e. 41 teachers and 287 final year students identified in the department of radio and television in all the 20 technical colleges accredited by NBTE to run NABTEB programs with specialization in radio, television and electronic works in the mentioned zone. No sampling was done because of the small and manageable size. The validators were trained technical teachers with three groups of highest qualifications of FTC/TTC/NCE, B.Sc/HND/PGDE and M.Sc/ Ph.D. The study reveals that a total of 38 final year students of the department of radio and television were purposively sampled from two of the 20 colleges based on the adequacy of all the models of equipment, materials and tools necessary for carrying out the test. This sample was used for try-out of the validated RTSAS instrument to determine its initial reliability. The developed instrument called RTSAS arose from the multi-stage approach suggested by Samarakoddy (2010).

After a critical review of literature, instrument (draft) so developed was preliminarily face and content validated by a panel of seven experts in technical education (three),measurement and evaluation (two) and radio and television technical teachers (two). Following their comments, a final instrument containing six basic tasks and 76 practical skill items was then assembled. The result of the pilot test carried out showed an internal consistency reliability of the instrument to be 0.86 using Cronbach-Alpha reliability coefficient.

After administering the final instrument on the respondents, data collected were analysed using the mean and standard deviation. A mean cut-off of 3.00 (moderately appropriate) was chosen. In other words, any practical skill with a mean score of 3.00 and above was appropriate, while a practical skill with a mean score below 3.00 was not appropriate. The study also tested the null-hypotheses at five percent level of significance, using one –way analysis of variance (ANOVA) and all statistical analysis was then carried out using statistical package for social sciences (SPSS) software.

The result of Okwelle's study gave a consideration to the inclusion of 76 skill activitiesas appropriate for use in assessing students' performance in practical areas of radio and television systems. He found out that his finding was in line with that of Garba (1993) with due respect that respondents considered appropriate all the test items for use in assessing students' psychomotor domain. The result also indicated no significant difference among the various groups of teachers who participated in the validation of the instrument. This is an evidence to show that the validity of the instrument was okay.

The implication of this study although apt is narrowly directed to radio and television systems in technical colleges, to the neglect of other areas involved in electronic practical especially at the basic levels. These areas may include power supply units, amplificationcircuits, oscillating circuits and fault diagnosis in instrumentslike voltmeters, ohmmeters, ammeters, cathode –ray-oscilloscopes, etc. These basic electronic areas also deserve to have reliable and valid instrument for evaluating students' practical projects. This is the hope of this present study to develop, validate and try-out a process assessment instrument for assessing students' practical performance in basic electronic in technical colleges in Delta State of Nigeria.

Summary ofReview ofRelated Literature

Review of literature in this work shows that the incorporation of the electronic practical in the formal school system dissolved the apprenticeship system where servants' performances were evaluated through observation after a specified period of time. And as it is, most of the trainings in this area of study are now taken over in Nigerian technical colleges.

Literature review in this work evidently shows that practical performance in electronic workshop practice has been assessed through end of course examinations conducted before by City and Guilds of London and now by West African Examination Council (WAEC) and NABTEB. Radio and television in NABTEB is offered at both intermediate and advanced levels in the State and Federal Technical Colleges. As stated in this work, intermediate scheme of work at the middle level include general education subjects (e.g. English Language and Mathematics) and the core trade subjects. In other to make a pass, every student is expected to pass both the written papers and the practical test in order to be certificated. Electronic workshop practices at any level are hinged on actual performance and not pseudo activities. In this regard, the various practical skill areas in the technical colleges and at NABTEB or WAEC curricula in electronic work especially at the basic level should be included in the instrument expected to come out of this study.

The high point of the review here is that the pen – and – paper – method of assessing practical based courses is grossly abused by both teachers and students despite the importance of practical skills in technical vocational education and training. Hence students are not often satisfied with their awarded marks/grades and many times complaint that their given grades do not really reflect the quality of their performance on the practical jobs. This is why the researcher attempts to developelectronic work test Instrument. This instrument (EWTI) would be based on specific performance objectives with a link to psychomotor domain.

In general terms, this literature review x-rayed some methods for constructing the instrument like constructing table of specification. The issues of qualities of test, theories of validity and reliability were not left out.

Lastly, recently conducted studies on the development of instruments in Nigeria greatly revealed that most of these instruments centered on cognitive and affective domains and are in the fields other thanelectronic. Therefore, this study focuses on the development of an instrument inelectronicpractice at technical college level for assessing students' practical performance inelectronic.

CHAPTER THREE

METHOD

This chapter discusses the research design, area of the study, population, and procedure for developing the instrument, validation of the instrument, reliability of the instrument, data collection and data analysis methods.

Research Design

Instrumentation is the design of this research study. Instrumentation is an aspect of research and development which has to do with the development of new material document, project, and so on (Okoye, 2015). It involves some specific techniques that wereadopted to achieve success by developing it and using the device. Hence the design is considered appropriate for use because new procedure technologies or instruments for educational purposes are to be introduced.

Area of the Study

The study was conducted in Delta State. The State is in zone one of NABTEB zoning system of Nigeria. Delta State also has six governmentapproved technical colleges (NBTE, 2001).Delta State government is embarking on massive campaign for the revitalization of technical institutions programs and electronic as one of the trade subjects in technical college is inclusive. A lot is presently being done to redeem the image of vocational and technical education and training in Delta State.

Population

The population is made up of 27 electronic work teachers in Delta State.This was made up of all electronic work teachers teaching in the six Delta State Technical Colleges. Theirnumber of year of teaching experience as well as their qualifications was taken into consideration in terms of whether they possess B.Sc (Technical Education) in Electronics, HND in Electronic with post Graduate Diploma in Education (PGDE) and Full Technological Certificate (FTC) in Electronic plus Technical Teachers’ Certificate (TTC).

technological growth and entrepreneurial education with a view to equipping the youths with requisite skills needed to convert them to employers of labour; Delta State was therefore best positioned to be the area of this present study.

Population

The population is made up of 27 electronic work teachers in Delta State. This was made up of all electronic work teachers teaching in the six Delta State Technical Colleges. Their number of year of teaching experience as well as their qualifications was taken into consideration in terms of whether they possess B.Sc (Technical Education) in Electronic, HND in Electronic with post Graduate Diploma in Education (PGDE) and Full Technological Certificate (FTC) in Electronic plus Technical Teachers' Certificate (TTC).

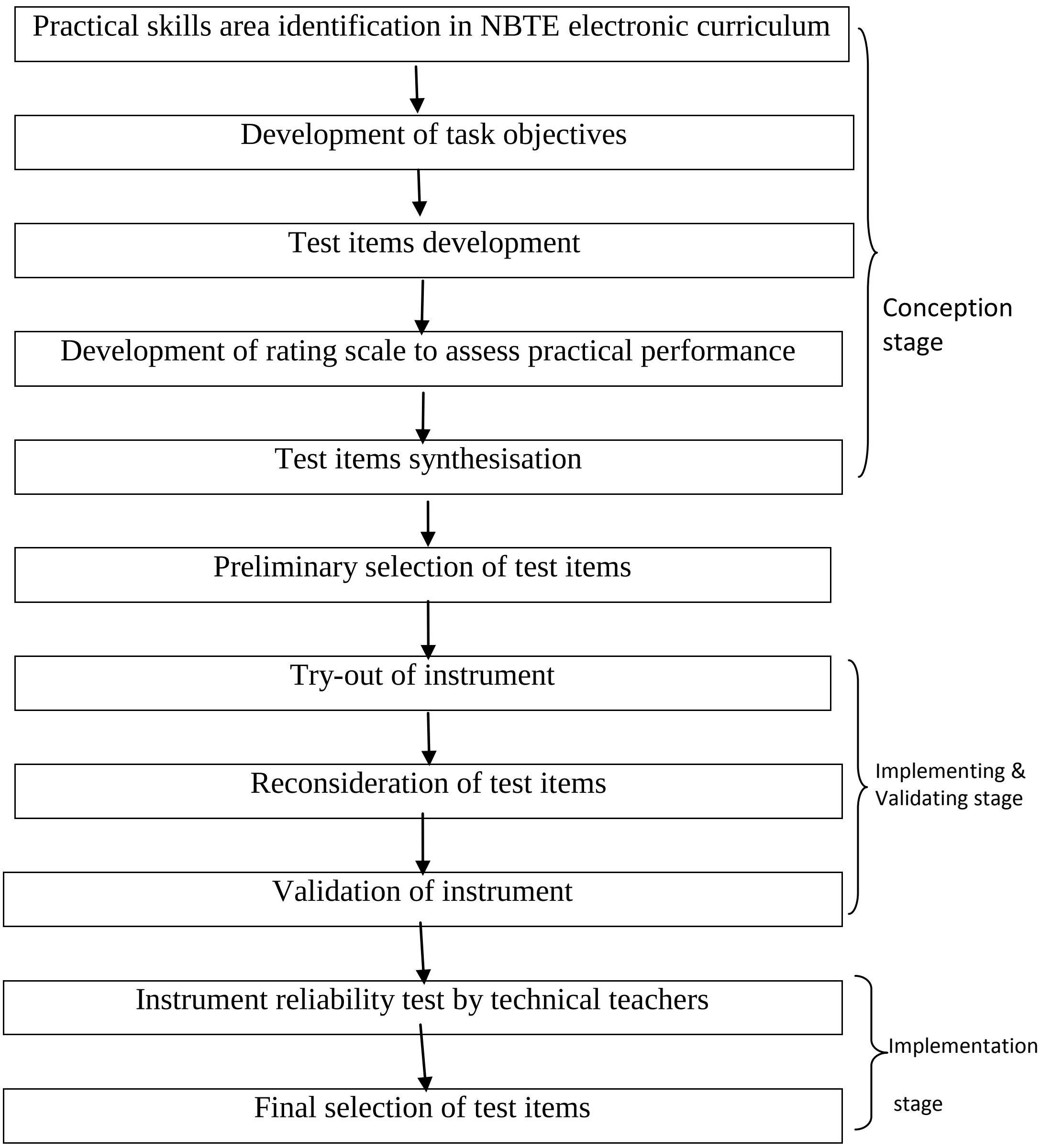
Sample and Sampling Technique

Consequent upon the few numbers, there was no sampling and hence the entire population was used. In this respect, a total population sample was appropriate because of the relative small population size. According to McLeod (2016), researchers could choose to study the entire population where the size of the population that has the particular set of characteristics of interest is typically very small so as not tomiss out significant piece of useful information. It is on the strength of this information that this study employed the entire population as the sample.

Developmentof Instrument

Theelectronic work test instrument (EWTI) was designed to assess candidates' practical performance inelectronic tasks. In carrying out this study, the researcher reviewed the approved National Technical Certificate (NTC) curriculum (Appendix H) in electronic work for technical colleges in Nigeria (NBTE, 2001). Tasks for the instrument under development were selected with consideration given to the various sections of practical activities in electronic work curriculum. These activities, as contained in NBTE syllabus, are: the use of tools correctly; basic electrical connection of resistors, capacitors, batteries; use of ohmmeters to test semi-conductor devices; electronic devices and circuits (e.g. setting up rectifying circuits, construction of power supply unit);troubleshooting/ repair of faulty power supply units; radio communication (dismantling and assembling) and removing installing and adjusting the cathode ray tube (CRT) in television tubes. The stages that are characteristic of instrumentation research are as shown below:

Fig.1: Stages Involved in the 1nstrument Development



Source Adapted from Chiejile (2006)-Ph.D

Consequently, consideration of various sections of practical skill areas in electronic syllabus took place in identifying practical related activities. This stage involved constructing items that measure practical skills in alignment with the number of practical activities involved in the process of accomplishing an identified task.

Following the above, a rating scale to assess students' practical performance was developed. These ratings have five points to one item. Fivepoints stood for Very Suitable (VS) whenever a test item is accurate in measuring the required skill at the performance stage of a task to be rated; four points stood for Suitable (S) and showed that thetest item has also measured accurately the intended skill as required in an activity of the job under the rating; three points stood for Moderately Suitable (MS) of the test item that measures a skill at an average level; two points depicted Unsuitable (US) and indicated that the test item measured below average the skill required at each operational stage of a task being rated and one point stood for Very Unsuitable (VU) to show that a test item measures very poorly the required skill at a performance stage of the task being rated.

Forthe next stage of the instrument development, the researcher sequentially patterned the test items with due consideration to the basic operations required in every task. It should also be noted that the researcher during the preliminary selection of test items considered test items that have the required and satisfactory characteristics. Every test item selected was based on the validation of instrument by experts in the field.

Thereafter, the draft of the instrument was given to four electronic teachers to try out its workability on 25 randomly selected final yearelectronic students. The four electronicteachers were taken from two Government Technical Colleges in Issele-Uku and Agbor, in Delta State and they were to observe and rate the students directly in the process of carrying out some tasks and the researcher simply supervised. Consequently, Cronbach Alpha coefficient was used to analyze the data collected in other to find the reliability of the draft instrument. This was so in other to draw a conclusion whether the instrument was reliable for use in the study. Anyway, some test items were reconsidered based on the raters' minor comments at this stage.

In other to carry out the reliability of the instrument on the items analyzed, the researcher used four electronic teachers (raters) in each of the six Technical Colleges in Delta State to administer the instrument. These teachers were also instructed on the negative influence of some other sources of errors in scoring (e.g. errors of central tendency, severity error, and generosity error and halo effect) in other to help to organize and rate their students respectively. At the end, the researcher sent copies of the instrument to some electronic teachers (raters) who used them to rate their students in practical performance under examination condition while the researcher supervised. At the end, Cronbach Alpha coefficient was used to analyze the data of every section and reliability was found to be 0.96, 0.95, 0.85, 0.86, 0.94 and 0.91 for sections 1 to 6 respectfully. Overall reliability was found to be 0.911. The instrument was therefore concluded to be reliable for use for the study. In the final stage, items considered satisfactory were included in the electronic work test instrument (EWTI).

Instrument for Data Collection

Theelectronic work test instrument (EWTI)(Appendix C) wasmade up of three sections and structured in line with the research questions and the raised null hypotheses of the study.

Section A is titled academic qualifications for teachers according to the possession of B.Sc Industrial Technical Education (electronic option) Degree, HND Electronic Technology /PGDE and Full Technology Certificate in Electronic/TTC.

Section B addressed electronic practice. It consists five tasks such as general metalwork (8items), connection of cells and other electronic components (10 items), use of multimeter for measurement indication (8items), electronic devices and circuit set up (9 items) and integrated circuit, semiconductors, oscilloscopes and power supply unit (7 items).

Section Caddressed design of simple electronic circuits. It contains test items on task 6 such as preparation of circuit parts, ability to construct single stage amplifier, multi vibrator using switches, etc as well as ability to trouble shoot faulty electronic gadgets (12 items).

Validation of the Instrument

Face and content validation of the instrument were done by three lecturers in Technology and Vocational and Technical Education Department, Faculty of Education, Nnamdi Azikiwe University, Awka, Anambra State and two other lecturers from Technical Education Department, Faculty of Education, Delta State University, Abraka in Delta State. These vocational and technical experts were requested to review and revise the test items where necessary as well as assist in rewording/ deleting/adding test items they considered appropriate. They were also asked to make general comments on the user – ability of the instrument being developed. The researcher then improved the content validity by re-evaluating table of specification (blue print) (Appendix E)in other to ensure that the test items comprehensively (adequately) covered the test blue print. The instrument content validity was also strengthened further by giving it to an expert in the Faculty of Education, Nnamdi Azikiwe University, Awka and one other lecturer from the Department of Technical Education, Faculty of Education, Delta State University Abraka, Delta State. They were requested to use Harrow's table of specification.

Reliability of the Instrument

The use of test –retest method was employed for the instrument's reliability. This wascarried out by the researcherwho administered the instrument under practical examination conditionto 30 final year electronic students who were selected randomly from Government Technical Colleges in Issele –uku and Agbor Delta State and after a period of two weeks, the researcher re-administered the same instrument to the same group of students and the reliability of the instrument was then determined to be 0.79 using Pearson Product Moment Correlation. This showed that the instrument was reliable as its error variance is 1-(0.79 x0.79) = 1-0.62=0.38.

Method of Data Collection

Copies of developed instrument were distributed by the researcher with the assistance of co-lecturers.These copieswere distributed to the raters (electronic lecturers) who used the questionnaire to assess the final year electronic students in their Technical Colleges. A total of 54 copies of the instrument were distributed. The response of the raters in each of the six State Technical Colleges was made in the instrument by checking ( ) with due regards to the extent of how the test items measured the required skills at every performance stage while the students carried out the activity.The number of questionnaire collected back by the researcher from the electronic teacherswas 54 showing that the truancy level in these colleges is zero. These 54 copies that were duly completed were subjected to item test analysis for the selection of items considered worthy of tasks for practical assessment employing criterion reference mean of the rating scale (3.00).

Method of Data Analysis

In other to describe the mean rating of the test items and the tasks respectively, mean and grand- mean were used. The concern of the test items in accordance with the rating of the raters is to determine their suitability for inclusion into the final instrument.

Criterion reference mean was employed. This is so because this evaluation is important in vocational and technical education and in other training programs in which a pre-determined level of knowledge or skill must be obtained before students are graduated and sent into labor market (Okoro, 2015). This level of knowledge or skill a student possesses is determined and an evaluation of how satisfactory or unsatisfactory, or pass or fail is given without reference to other students. This criterion mean addresses the data collected by research question which talks about the suitability of test items to be included in students' practical work in electronic trades. Test items with mean ratings of 4.50 and above are regarded as very suitable, test items with mean ratings of 3.50 – 4.49 were regarded as suitable; test items with mean rating of 2.50 -3.49 were regarded as moderately suitable while test items with mean ratings of less than 2.50 were regarded as unsuitable. Test items with mean ratings of 3.50 and above were selected for the instrument after the item test analysis.

Research question 1, about the appropriate practical tasksthat were included in the instrument for assessing students' practical work in electronic was analysed using mean of means (i.e. average of the mean score of the test items in each task). Criterion mean statistic was used to analyse responses of electronic teachers on the test items based on research question 2.

Range	**Points**	**Real Limit**
Very suitable (VS)	5	4.50- 5.00
Suitable (S)	4	3.50- 4.49
Moderately Suitable (MS)	3	2.50-3.49
Unsuitable (US)	2	1.50-2.49
Very unsuitable (VU)	1	1.00-1.49

For research question3, the content validity was determined using Harrows taxonomy of psychomotor objectives for test items generation As stated before, ideas of experts in technical education and measurement and evaluation were also used to determine the face and content validation.

The Cronbach Alpha coefficient was used to test the degree of reliability of each task and the entire instrument while addressing research question 4. The two null hypotheses were tested at 0.05 level of significance using one –way Analysis of Variance (ANOVA). Scheffe's multiple range test was used to test the direction of the difference(mutually inclusive and coherent)among the three group raters. The analysis of the collected data for this study was done with the aid of the computer program – Statistical Package for the Social Science (SPSS).

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF DATA

This chapter gives the analysis of the statistical methods used in connection with the hypothesis and findings of the study. Grand mean and mean ratings were used to analyze the data related to the research questions while the one-way analysis of variance (ANOVA) was used to test the hypotheses. Scheffe's multiple range test was employed to show the direction of the difference among the three groups of raters.

Results of Research Questions

Research Question 1

What are the tasks in electronic work that should be included in an electronic test work instrument (EWTI)?

In answering research question 1, the grand mean of the electronic tasks has been found.The summary is shown in Table1.

Table 1
Grand meanratings of electronic work tasks areas for inclusion in electronic work test instrument

S/N	TASK	GRANDMEAN	REMARK
1.	General metalwork	3.58	suitable
2.	Connection of cells and other electronic components.	3.71	suitable
3.	Use of multimeter for measurement indication.	3.78	suitable
4.	Electronic device and circuit set-up	3.79	suitable
5.	Integrated circuit (IC), semiconductors, oscilloscopes and power – supply – unit.	3.63	suitable
6.	Design of simple electronic circuit	3.99	suitable

The Grand Mean of the electronic task areas ranged from 3.58to 3.99 as could be seen in the analysis presented in Table 1. The least Grand Mean was noted on task 1 which is general metalwork. The highest Grand Mean of 3.99 was obtained by task 6. All tasks had the Grand Means above the cutoff point of 3.50 and were considered suitable. Task 1 (general metalwork) had the lowest Grand mean of 3.58 and was also considered suitable.

Research Question 2

What test items are suitable for assessing students' practical work in electronic trades?

In response to research question 2, data collected are presented in Tables 2 to 9. Every table has the result analyzed below it.

Table 2
Mean ratings of test items for assessing students' practical performance on electronic practical general metalwork

S/N	TASK	MEAN	REMARK
1.	Ability to use tools and protective eye shields correctly.	3.64	Suitable
2.	Selection of hand tools for carrying out tasks.	3.69	Suitable
3.	Correctly grind drill point angles to fix wires.	3.88	Suitable
4.	Perform metal joining by soldering.	3.28	Not Suitable
5.	Cutting of breadboard to size using hack saw.	3.64	Suitable
6.	Marking out of materials using a range of tools.	3.69	Suitable
7.	Correctly handling and using portable power tools.	3.18	Not Suitable
8.	Effective use of types of files, e.g. flat, square, etc.	3.56	Suitable
	GRAND MEAN	**3.58**	**Suitable**

Analysis in Table 2 indicated that the mean ratings of test items ranged from 3.18 to 3.88. The Grand Mean of the tasks was 3.58 (average of the means of the test items in the task). Based on this premise, all the test items were considered acceptable, appropriate and suitable for inclusion into the electronic work test instrumentexcept test items 4 and 7 with mean rating of 3.28 and 3.18 respectively. The mean ratings were low probably as a result of insufficient knowledge in terms of metal soldering and correct method of handling and using power tools among the three categories of raters. Nonetheless, the tasks were included in the instrument though subject to review. Test item 3 was rated highest with a mean rating of 3.88.

Table 3
Teachers' Mean Ratings of test items on connection of cells and other electronic components

S/N	TASK	MEAN	REMARK
9.	Ability to identify primary cells.	3.52	Suitable
10.	Test for the condition of a cell or battery.	3.69	Suitable
11.	Ability to connect cells in series and parallel.	3.64	Suitable
12.	Series – parallel connection cells in a circuit.	3.69	Suitable
13.	Ability to connect resistors in series.	3.92	Suitable
14.	Ability to connect resistors in series -parallel.	3.89	Suitable
15.	Connection of resistors in series -parallel.	3.73	Suitable
16.	Ability to connect capacitors in series.	3.59	Suitable
17.	Correctconnection of capacitors in parallel.	3.79	Suitable
18.	Connection of capacitors in parallel- series.	3.62	Suitable
	GRAND MEAN	**3.71**	**Suitable**

Table 3 shows the respondents mean ratings for the test items for assessing practical performance on the connection of cells, and other electronic components. The mean rating ranged from 3.52 to 3.92. The Grand Mean here is 3.71. As could be seen, all the test items had mean ratings that qualified them as appropriate and acceptable/suitable for the instrument. All the test items were, therefore, found suitable for inclusion into the instrument having been rated more than 3.50 which is the cut-off point.

Table 4

Mean Ratings of test items for assessing electronic students' practical on the use of multimeter for measurement indication

S/N	TEST ITEMS	MEAN	REMARK
19.	Identification of functional parts of multimeter.	3.65	Suitable
20.	Use of meter to read DC and AC voltage measurement.	3.53	Suitable
21.	Ability to read resistance measurement using meter.	3.77	Suitable
22.	Use of meter to read DC and AC current measurement..	3.51	Suitable
23.	Ability to use ohmmeter to test diodes and transistors.	3.92	Suitable
24.	Ability to identify faults in meter.	3.74	Suitable
25.	Ability to ratify faults in meter.	3.98	Suitable
26.	Ability to identify fault components in electronic	4.11	Suitable
	GRAND MEAN	**3.78**	**Suitable**

Analysis result in Table 4 gave mean ratings of test items in a range of 3.51 to 4.11 with a Grand Mean of 3.78. Going by those mean ratings, the whole eight items were suitable for inclusion into the instrument. The items were therefore, retained because they had mean ratings above the cut-off mark of 3.50 already set for selecting the test items. Test item which was on the ability to use meter to read AC and DC measurement was rated 3.51 while test item 20 had a mean rating of 4.11 as the highest mean rating.

Table 5
Mean Ratings of test items on electronic devices and circuit set-up

S/N	TEST ITEMS	MEAN	REMARK
27.	Ability to set-up rectifier circuits.	3.85	Suitable
28.	Ability to build a simple smoothing circuit.	3.70	Suitable
29.	Ability to apply filtering circuit at rectifier output.	3. 52	Suitable
30.	Ability to identify transistor type PNP and NPN.	3.74	Suitable
31.	Setting up laboratory experiment to plot transistor characteristic.	3.86	Suitable
32.	Use of meter to identify thetype of transistors.	3.79	Suitable
33.	Ability to use meter to test transistor terminals.	3.84	Suitable
34.	Correct use of meter to identify the base, emitter and collector and transistor condition.	3.94	Suitable
35.	Ability to identify various pins of a transistor.	3.92	Suitable
GRAND MEAN		**3.79**	**Suitable**

Result of Table 5 shows that the mean rating of the respondents on the nine items ranged from 3.52 to 3.94.The least mean rating was obtained from test item 29 which was on ability to apply filtering circuit at rectifier output. Test item 34 had the highest mean rating while the Grand Mean for the entire task was 3.79. All the test items (9 in number) had mean rating of 3.50 and above and were therefore considered suitable for the task.

Table 6
Teachers' mean Ratings of test items on integrated circuit, semi-conductors, oscilloscopes and power supply unit.

S/N	TEST ITEMS	MEAN	REMARK
36.	Identification of the functional parts of oscilloscopes.	3.72	Suitable
37.	Ability to determine various waveforms by applying signals to the oscilloscope.	3.27	Not Suitable
38.	Ability to assemble stabilized low voltage power supply unit.	3.64	Suitable
39.	Identification of the place of power supply unit in a complex circuit.	3.62	Suitable
40.	Ability to identify samples of capacitors and indicators used in power supply	3.72	Suitable
41.	Exhibition of power supply with transformer	3.84	Suitable
42.	Exhibition of power supply without transformer	3.58	Suitable
	GRAND MEAN	**3.63**	**Suitable**

Table 6 analysis showed that mean ratings of the respondents on the seven items ranged from 3.27 to 3.84. The least mean rating was found from test item 36, which was meant to identify the functional parts of oscilloscope. The highest mean rating of 3.84 was observed for test item 41. The Grand Mean rating of the whole task was 3.63. Only test item 36 with the mean rating of 3.27 was unsuitable and hence was not included while all other ones that had mean ratings of 3.50 and above were considered appropriate and suitable for inclusion into the instrument.

Table 7

Mean ratings of teachers on test items for assessing design of simple electronic circuit

S/N	TEST ITEMS	MEAN	REMARK
43.	Preparation of circuit part lists printed circuit board details, street metal details etc.	3.64	Suitable
44.	Ability to construct single stage amplifier.	3.89	Suitable
45.	Ability to construct oscillator.	3.84	Suitable
46.	Ability to use soldering iron and lead to join wires and component terminals together.	4.05	Suitable
47.	Ability to demonstrate the operation of a bistable multivibrator using switches and electronic bulbs.	4.13	Suitable
48.	Ability to construct a multivibrator circuit (flip flop).	4.02	Suitable
49.	Identify simply logic circuit of AND, OR and NOT gates.	3.82	Suitable
50.	Ability to set up a public address system	4.31	Suitable
51.	Ability to operate a public address system	4.37	Suitable
52.	Troubleshooting faulty electronic gadgets.	3.95	Suitable
53.	Ability to rectify faulty address system	3.59	Suitable
54.	Application of safety regulation in electronic work practice	4.22	Suitable
	GRAND MEAN	3.99	Suitable

As shown in Table 7, respondents rated all the 12 test items suitable for use in the final instrument with mean ratings ranging from 3.59 to 4.31. Test items 50 on ability to set up a public address system had the highest meanrating of 4.31. The 12test items were adjudged acceptable to be included in the instrument, since all the items had mean ratings of more than 3.50.

In general, 51 test items out of the 54 test items under consideration had meanratings of 3.50 and above and were considered to be acceptable test items for inclusion into the instrument. The remaining three test itemsthat had mean ratings below 3.50 were considered unsuitable for inclusion in the instrument and were subsequently dropped.

Research Question 3

How valid is the electronic work test instrument developed for assessing students' practical work?

In order to do justice to this research question 3, the content validity of the test item was determined. This was done in accordance with the opinion of Ajayi and Abanobi (2016) that the content validity should be considered to play a major role in the development of various types of test used in education. The procedure for achieving this included: identifying the six psychomotor/practical areas of the NTC curriculum in electronic; building a table of specifications as in Appendix E based on Harrow's taxonomy of psychomotor /practical objectives, this followed a process of operational analysis and then the generation of test items which closely fit the table of specifications. The appropriateness of the test items was carried out by experts in Technical Education and Measurement and Evaluation in terms of the face and content validity of the instrument respectively. Summarily, there were four test items on Reflex Movement (RM), 10 test items on Basic Fundamental Movement (BFM), 10 test items on Perceptual Abilities (PA), 12 test items on Physical Abilities (PH.A), 13 test items on Skilled Movement (SM) and five test items on Non- Discursive Communication (NDC).

It should be noted that the distribution of these test items vis-a-vis their psychomotor/practical level was according to the different weightings of the various electronic tasks in the NTC curriculum. In addition, the practical activities involved in each electronic task have different sequence of operation. Consequent upon the comment of the experts who validated the developed EWTI for assessing students practical performance in electronic, the instrument attested as a guide for carrying out students assessment in electronic work in technical colleges.

Research Question 4

How reliable is the electronic test instrument developed for assessing students' practical work?

Table 8 shows the reliability coefficients of the six clusters of electronic work tasks for assessing students' practical work performance.

Table 8
Reliability estimates (Cronbach Alpha) for test items on electronic practical work

SN	Electronic Practical Work Task	Reliability Coefficient ( )
1.	General metalwork (involved in electronic)	0.96
2.	Connection of cells and other electronic components	0.95
3.	Use of multimeter for measurement indication	0.85
4.	Electronic devices and circuits set-up	0.86
5.	Integrated circuit, semiconductors, oscilloscopes and power supply unit	0.94
6.	Design of simple electronic circuit	0.91

The analysis of Table 8 revealed that each of the six electronic work tasks had a high reliability coefficient that ranged from 0.85 to 0.96. The indication of this coefficient is that the instrument was a refined test in consonance with the recommendation of David (2016) who said that generally, the standard Cronbach Alpha in the social sciences, as elsewhere, is 0.70 and above.

In this view, the answer to the research question about the reliability of the instrument would be in the affirmative. Thus, the test items in the electronic work test instrument (EWTI) were reliable for assessing students' practical work in electronic in Technical Colleges.

Hypothesis Testing

Hypothesis1

Technical teachers do not differ significantly in their ratings of the test items to be included in electronic work test instrument (EWTI) based on their academic qualifications.

The relevantdata shown in Table 9 were collected in respect of hypothesis 1. One –way-analysis of variance (ANOVA) between technical teachers on electronic work instrument (EWTI) was applied.

Table 9

One-Way ANOVA between the teachers on Electronic Work Test Instrument (EWTI)

Task	Sum Of Squares Between Groups	Sum of Squares Within Groups	df Between Groups (K-1)	df Groups Within (N-K)	Mean Squares Between Groups	Mean Squares Within Groups	F-Critical	F-Sig.	Remark
1	5.85	2.37	2	21	2.92	0.11	25.89	0.000	Sigf
2	4.66	1.43	2	27	2.33	0.05	43.97	0.000	Sigf
3	2.17	2.08	2	21	1.08	0.10	10.91	0.001	Sigf
4	3.62	1.40	2	24	1.81	0.06	30.99	0.000	Sigf
5	6.12	1.44	2	18	3.06	0.08	38.36	0.000	Sigf
6	4.24	4.37	2	33	2.12	0.13	16.01	0.000	Sigf

Table 9 reveals the F- ratio of the mean ratings of teachers on students' practical work in electronic tasks. The indication of the analysis is that there was significant difference in the mean ratings of the three groups of teachers at 0.05 level of significance given df 2 and 21, 27, 21, 24, 18 and 33 on the tasks one, two, three, four, five and six respectively. In all the tasks, the F-critical calculated was greater than the F-critical ratio. This result indicated that the null hypothesis of no significant difference was rejected in all the electronic work tasks. As a result of this outcome, Scheffe's multiple range of comparison was conducted. The analysis is presented in Table 10.

Table 10
Scheffe's Multiple Range Comparism of the Mean Ratings of Electronic Teachers on electronic work tasks

Tasks	Group 1	Group 2	Group3
1.	24.0	28.13*	33.64*
2.	33.2	35.65*	42.51*
3.	28.0	29.13	*33.57*
4.	31.0	32.77	*38.71*
5.	21.2	24.64*	30.36*
6.	43.6*	42.52	53.42*

Key

* = significance between groups at 0.05 level of significance

Group 1 = B.Sc Electronic Teachers

Group 2= HND Electronic Teachers

Group3 = FTC Electronic Teachers

Analysis inTable 10 reveals that there is significant difference between the mean ratings of the B.Sc teachers and FTC teachers on tasks 6. This indicated that the B.Sc teachers rated task 6 lower than the FTC teachers. Table 11results further indicated that there was significant difference between the mean ratings of the HNDteachers and FTC teachers. The analysis also showed that there is no significant difference among the mean ratings of the B.Sc, HND and FTC teachers on task 4.

Hypothesis 2

Electronic teachers do not differ significantly in their ratings as regards the tasks to be included in electronic work test instrument (EWTI) based on their years of experience.

In this hypothesis, mean ratings of B.Sc, HND and FTC teachers on the 54 test items were analyzed using One-Way Analysis of variance (ANOVA). Results of this are presented in table 11.

Table 11
One-Way ANOVA showing the Test Items for the Electronic Work Test Instrument (EWTI)

	Test Items	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_3$	SD_1	SD_2	SD_3	Cal F	Table F	df_1	df_2	Scheffe's Multiple Range Test
Task 1	1	3.00	3.50	4.43	0.89	0.87	0.90	3.33	3.47	2	21	NS
	2	3.20	3.75	4.14	1.33	0.97	1.06	3.30	3.47	2	21	NS
	3	3.40	3.75	4.50	1.02	1.09	0.63	3.31	3.47	2	21	NS
	4	3.20	3.00	3.64	1.17	1.22	0.89	3.29	3.47	2	21	NS
	5	3.00	3.50	4.43	0.89	0.87	0.90	3.33	3.47	2	21	NS
	6	3.20	3.75	4.14	1.33	0.97	1.06	3.30	3.47	2	21	NS
	7	2.20	3.00	4.36	1.17	1.00	0.61	3.42	3.47	2	21	NS
	8	2.80	3.88	4.00	0.75	1.05	0.85	3.33	3.47	2	21	NS
Task 2	9	3.20	3.00	4.36	0.75	1.00	0.61	4.78*	3.35	2	27	HND/FTC
	10	3.40	3.38	4.29	1.02	0.99	0.80	4.75*	3.35	2	27	FTC/BSC
	11	3.00	3.50	4.43	0.89	0.87	0.90	4.78*	3.35	2	27	FTC/BSC
	12	3.20	3.75	4.14	1.33	0.97	1.06	4.75*	3.35	2	27	FTC/BSC
	13	3.60	3.75	4.43	1.02	0.97	0.90	4.74*	3.35	2	27	FTC/BSC
	14	3.80	3.75	4.14	0.75	0.97	1.06	4.73*	3.35	2	27	FTC/BSC
	15	3.20	3.63	4.36	1.17	0.99	0.61	4.76*	3.35	2	27	FTC/BSC
	16	3.40	3.38	4.00	0.49	1.32	0.85	4.74*	3.35	2	27	FTC/BSC
	17	3.40	3.63	4.36	0.49	0.86	0.61	4.75*	3.35	2	27	FTC/BSC
	18	3.00	3.88	4.00	0.63	1.05	0.85	4.76*	3.35	2	27	FTC/BSC
Task 3	19	3.60	3.00	4.36	0.80	0.71	0.61	3.33	3.47	2	21	NS
	20	3.40	3.50	3.71	0.49	1.32	0.88	3.28	3.47	2	21	NS
	21	3.20	3.75	4.36	0.75	0.66	0.61	3.31	3.47	2	21	NS
	22	3.40	3.50	3.64	0.49	1.00	0.89	3.28	3.47	2	21	NS
	23	3.60	3.75	4.43	0.49	1.20	0.90	3.30	3.47	2	21	NS
	24	3.20	3.88	4.14	0.40	0.93	1.06	3.30	3.47	2	21	NS
	25	3.80	4.00	4.14	0.75	0.87	1.06	3.28	3.47	2	21	NS
	26	3.80	3.75	4.79	0.75	0.97	0.56	3.31	3.47	2	21	NS
Task 4	27	3.40	4.00	4.14	1.20	1.32	0.91	4.01*	3.40	2	24	FTC/BSC
	28	3.20	3.75	4.14	1.33	0.97	1.06	4.02*	3.40	2	24	HND/FTC
	29	3.20	3.00	4.36	1.17	1.00	0.61	4.06*	3.40	2	24	FTC/BSC

	Test Items	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_3$	SD_1	SD_2	SD_3	Cal F	Table F	df_1	df_2	Scheffe's Multiple Range Test
	30	3.20	3.38	4.64	1.17	0.99	0.72	4.06*	3.40	2	24	FTC/BSC
	31	3.40	3.75	4.43	1.36	1.09	0.90	4.02*	3.40	2	24	FTC/HND
	32	3.60	3.63	4.14	1.20	1.41	1.06	4.01*	3.40	2	24	FTC/BSC
	33	3.60	3.50	4.43	1.20	0.87	0.90	4.02*	3.40	2	24	FTC/BSC
	34	3.80	3.88	4.14	0.75	1.05	0.83	4.00*	3.40	2	24	HND/FTC
	35	3.60	3.88	4.29	1.02	0.78	0.59	4.01*	3.40	2	24	BSC/FTC
Task 5	36	2.80	2.88	4.14	1.17	1.27	0.83	2.64	3.56	2	18	NS
	37	3.00	3.75	4.43	1.10	0.97	0.73	2.62	3.56	2	18	NS
	38	2.80	3.75	4.36	0.75	0.83	0.61	2.63	3.56	2	18	NS
	39	3.20	3.38	4.29	1.17	1.32	0.70	2.60	3.56	2	18	NS
	40	3.20	3.75	4.21	1.33	0.97	1.08	2.60	3.56	2	18	NS
	41	3.60	3.63	4.29	0.80	1.41	1.10	2.58	3.56	2	18	NS
	42	2.60	3.50	4.64	0.80	1.00	0.61	2.67	3.56	2	18	NS
Task 6	43	2.80	3.63	4.50	0.75	0.99	0.63	6.26*	3.29	2	33	HND/FTC
	44	3.80	3.75	4.14	0.75	0.83	0.99	6.19*	3.29	2	33	FTC/BSC
	45	3.80	3.50	4.21	0.75	1.22	0.94	6.20*	3.29	2	33	FTC/BSC
	46	3.80	4.00	4.36	0.40	0.87	0.89	6.19*	3.29	2	33	FTC/BSC
	47	4.00	3.75	4.64	0.63	0.97	0.61	6.20*	3.29	2	33	FTC/HND
	48	3.60	3.75	4.71	0.80	0.97	0.59	6.22*	3.29	2	33	FTC/HND
	49	3.20	3.63	4.64	0.75	0.70	0.61	6.24*	3.29	2	33	FTC/BSC
	50	4.20	4.38	4.36	0.75	0.70	0.72	6.19*	3.29	2	33	FTC/HND
	51	4.00	4.25	4.86	0.89	0.83	0.35	6.20*	3.29	2	33	FTC/BSC
	52	3.60	3.88	4.36	0.80	1.05	0.81	6.20*	3.29	2	33	FTC/BSC
	53	2.60	3.75	4.43	1.02	0.83	0.73	6.27*	3.29	2	33	FTC/HND
	54	4.20	4.25	4.21	0.75	0.66	0.77	6.19*	3.29	2	33	FTC/BSC

*the Mean difference is significant at the 0.05 level of significance

Table 11 showed that the F- ratio calculated were higher than the table F in test items 9 to 18 on task 2, also on test items 27 to 35 on task 4 and test items 43 to 54 on task 6. This indicated that the null hypothesis of no significant difference was rejected on the above electronic work test items but accepted in the remaining test items. Further analysis showed the sources of the differences among the groups as disclosed by applying Scheffe's multiple choice comparison statistics between groups.

Findings

The following are the findings based on the analysis of data for this study.

1. *Electronic work tasks in the instrument (EWTI).*

The finding revealed that the following six tasks should be included in the instrument.

A. Electronic practical general metal work.
B. Connection of cells and other electronic components.
C. Use of multimeter for measurement indication.
D. Electronic devices and circuit set-up.
E. Integrated circuits, semiconductors, oscilloscopes and power supply unit.
F. Design of simple electronic circuit.

2. *Test items included in the instrument (EWTI)*

Fifty- one test items out of the 54 test items were included in the instrument based on the 3.50 cut-off point item test analysis. These test items are:

A. **Electronic practical general metal work**

Specific work tasks are:

(i) Use tools and protective eye shield correctly.
(ii) Select hand tools for carrying out tasks.
(iii) Grind drill point angles correctly to fix wires.
(iv) Perform metal joining by soldering.
(v) Cut breadboard to size using hacksaw.
(vi) Mark out materials using a range of tools.
(vii) Correctly handle and use portable power tools.
(viii) Use different types of files correctly.

B.Connection of cells and other electronic components

Specific work tasks are:

(i)Identify primary cells.

(ii)Test for the condition of a cell of a battery.

(iii)Connect cells in series and parallel.

(iv)Series-parallel connection of cells in a circuit.

(v) Connect resistors in series.

(vi) Connect resistors in parallel.

(vii) Connect resistors in series-parallel.

(viii) Connect capacitors in series.

(ix) Connect capacitors in parallel.

(x) Connect capacitors in parallel-series.

C. Use of multimeter for measurement indication

Specific work tasks are:

(i) Identify functional parts of multimeter.

(ii) Use meter to read DC and AC voltage measurement.

(iii)Read resistance measurement using meter.

(iv)Use multimeter to read DC and AC current measurement.

(v) Use ohmmeter to test diodes and transistors.

(vi)Identify faults in meters.

(vii) Rectify faults in meters.

(viii) Identify faulty components in electronic.

D. Electronic devices and circuit set-up

Specific work tasks are:

(i) Ability to set-up rectifier circuits.

(ii) Ability to build a simple smoothing circuit.

(iii)Ability to apply filtering circuit at rectifier output.

(iv)Ability to identify transistor type PNP and NPN.

(v) Set-up laboratory experiment to plot transistor characteristics.

(vi)Use meter to identify the type of transistors.

(vii) Ability to use meter to test transistor terminals.

(viii) Correctly use meter to identify base, emitter and collector and transistor condition. (ix) Ability to identify various pins of transistor.

E. Integrated circuit, semiconductors, oscilloscopes and power supply unit

Specific work tasks are:

(i) Identify functional parts of oscilloscopes.

(ii) Ability to determine various waveforms by applying signals to the oscilloscopes.

(iii) Ability to assemble stabilized low voltage power supply unit.

(iv) Identify the place of power supply unit in a complex circuit.

(v) Exhibit power supply unit with transformer

(vi) Exhibit power supply unit without transformer

F. Design of simple electronic circuit.

Specific work tasks are:

(i) Prepare circuit part list on printed circuit board.
(ii) Ability to construct single stage amplifier.
(iii) Ability to construct oscillator.
(iv) Ability to use soldering icon and lead to join wires and component terminals together.
(v) Ability to demonstrate the operation of a hi stable multivibrator using switches and electronic bulbs.
(vi) Ability to construct a multivibrator circuit (flip-flop).
(vii) Identify simple logic circuit of AND, OR and NOT gates.
(viii) Ability to set-up a public address system.
(ix) Ability to operate a public address system.
(x) Troubleshoot faulty public address system.
(xi) Ability to rectify faulty public address system.
(xii) Application of safety regulations in electronic work.

3. Validity of the Instrument developed

Findings revealed that the developed instrumenthas a high face and content validity. This was consequent upon the fact that the test items were able to properly measure the various skills that were needed to accomplish the different tasks.For face validity, experts in electronic work section of Technology and Vocational Education and Measurement and Evaluation from Delta State University, Abraka and NnamdiAzikiwe University, Awka respectively reviewed the instrument. The experts deleted seven test items from the initial draft of 61 test items, reworded 20 test items and made satisfactory comments about the entire instrument.

In terms of the content validity, the instrument covered the practical work areas of electronic in the NTC curriculum and the Harrow's model was used in preparing the specification table.Four test items represented the Reflex Movement, ten test items covered the Basic Fundamental Movement, ten test items represented Perpetual Abilities; twelve test items represented Physical Abilities; thirteen test items covered the skilled Movements and five represented Non-discursive Communication (Appendix E).

Reliability of the Instrument Developed

The reliability of the instrument was determined using Cronbach Alpha coefficient (x) for the six task areas of electronic work. The reliability ranged from 0.86 to 0.96. The reliability for the whole instrument was 0.89. This showed that the instrument is highly reliable.

Hypotheses

The findings here showed that:

1. There was no significant difference in the mean ratings of B.Sc, HND and FTC electronic teachers who rated tasks 1,2,3,4,5,6,7, and 8 while there was significant difference in the mean ratings of test items 9, 10, 11,12,13,14,15,16,17 and 18. The point here is that the raters did not discriminate in their ratings on task 1 while they did so for task 2. In the attempt to show the direction of the difference among the groups of raters on the rated tasks, the Scheffe’s Multiple Range test was employed for pair-wise comparison of the groups. It showed that the FTC teachers rated the tasks higher than the other groups, followed by HND teachers while the B.Sc. Teachers had the lowest mean ratings on the tasks.
2. There was also no significant difference in the mean ratings of the B.Sc, HND and FTC teachers concerning the test items that would be put in the instrument (EWTI) in all the test items, except in the test items, numbers 9 to 18 on task one, 27 to 35 on task two and 43 to 54 on task six where the calculated F-ratios were higher than the table F.

Summary of Findings

Thesummary of findings in this study is succinctly put down here. The first is that all the six electronic work tasks are necessary to be included in the instrument developed. Secondly, 51 out the 54 test items are suitable for inclusion in instrument developed based on the 3.50 cut-off point item test analysis. These test items have already been listed.

The developed instrument has a high content validity. This is because the test items are able to properly measure the various skills needed to accomplish the different tasks. It also has appreciable face validity. This is because it was reviewed by experts in electronic work section of Technical Education and Measurement and Evaluation from Delta State University, Abraka and Nnamdi Azikiwe University, Awka. Consequently, the developed instrument covers the practical work areas of electronic in the NTC curriculum and the Harrow's model was used in preparing the specification table.

Finding on the reliability of the developed instrument shows that it has reliability coefficient that ranged from 0.86 to 0.96 for the six task areas of electronic work. The reliability for the whole instrument is found to be 0.89 and shows that the instrument is highly reliable.

On the hypotheses, summary of finding shows that FTC teachers rated students' practical work higher than the HND teachers while B.Sc teachers had the lowest mean ratings on the tasks. It is also noted that there is no significant difference in the mean ratings of the B.Sc, HND and FTC teachers concerning the test items in the instrument developed.

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMEDATIONS

This chapter contains the summaries of the problems, procedures employed in conducting the study and the major findings of the study. The implications of the study, limitations of the study, conclusion, recommendations and suggestions for further research are also found in this chapter

Discussion of Results

In this study, findings have been arranged and discussed according to the research questions and two null hypotheses formulated. The finding that 51 out of 54 test items were considered suitable in EWTI was supported by the studies of Chiejile (2006) and Okwelle (2010). Emphases in their works revealed that test items that satisfied all psychometric properties are enough and adequate for inclusion in test instrument. Test item 54 in Table 7 received a high mean of 4.22 to show how important the application of safety regulation in electronic work is. Okoye (2015) emphasized that correct observation of safety rules in electronic work is key and when it is practically and strictly adhered to, short- circuiting and any other injuries would be avoided.

Three of the 54 test items had mean ratings that were below the cut-off of 3.50 and so were dropped. The six electronic task areas showed Grand Mean ranging from 3.58 to 3.99 revealing that the six task areas were suitable for the instrument based on the criterion of 3.50 cut-off points. The only three tasks that could not meet the cut-off point were not included.

Hypotheses results showed that there was no significant difference in the mean ratings of the three groups of teachers on the electronic tasks for assessing students' practical performance in electronic practical general metalwork, connection of cells and other electronic components as well as integrated circuit, semiconductors, oscilloscopes and power supply unit in tasks 1, 3 and 5 respectively. There was, however, a significant difference in the mean ratings of teachers on the other three tasks. This was a pointer to show that the raters agreed in their ratings on three tasks and discriminated in the other three. The simple reason for this disparity in ratings could be due to the fact that the different group of raters must have received different practical and pedagogical exposures during their training in schools.

Analyses of Scheffe's' multiple range test revealed that the FTC teachers rated the tasks higher than all the groups, followed by HND teachers while the B.Sc had the lowest mean ratings on the tasks. The researcher viewed that the FTC teachers rated the tasks higher as a result of their practical training background in electronic and this must have contributed to their better understanding of the skills involved in each electronic task. Not only this, their higher ratings on the tasks might also have something to do with their knowledge of the skills demonstrated by the students during the workshop practice exercise. It is fully important to note that workshop exercises make way for good devotion to the profession. This theory was supported by Akinseinde (2016) by stressing that working in a workshop increases the knowledge of the students and teachers and that the workshop exercises contributed to the realization of modern tendencies to bring educational process nearer to the production.

The finding on the electronic test items that would be included in the instrument indicated that there was no significant difference in the mean ratings of teachers on 20 test items. The finding also indicated that there was significant difference in the mean ratings of teachers on 31 test items. Thus, in this study, the test items in the instrument were adequate for assessing electronic students in technical colleges. This finding was supported by Ofulue (2000) who stated that test items that satisfied all psychometric properties were adequate for inclusion in test instrument.

Summary of Procedures Adopted in the Study

Appropriate and relevant literature for this study was reviewed in line with stated objectives of this study: development and validation of electronic instrument for assessing students' practical performance in electronic in technical colleges. The focus of the study was on electronic task areas, test items to be included in the instrument, validity and reliability of the instrument.

In this study, four research questions were answered and two null hypotheses tested at 0.05 level of significance. The research design was instrumentation and was used to collect data employed to answer the research questions and to test the null hypotheses. Test items well formulated and developed were utilized. The population comprised 27 electronic work teachers in the six Delta State technical colleges holding B.Sc, HND and FTC qualifications in electronic. Sequel upon their few numbers, the entire population was used as sample. The 27 electronic teachers followed explanation by the researchers to assess all the electronic students in their various colleges. A test-retest method of testing reliability using Pearson – Product-Moment was used to find the reliability of the instrument. Experts in electronic section of Technology and Vocational Education and Measurement and Evaluation of Educational Foundations validated the instrument.

TheElectronic Work Test Instrument (EWTI)had three sections A-C. Section A was on academic qualification of teachers, Section B addressed electronic practice tasks while Section C addressed design of simple electronic circuit tasks. Copies of the developed instrument were given to the electronic teachers to administer on their students. Data collected were analysed using Mean, Grand Mean. Cronbach Alpha, Pearson- Product Moment Correlation Coefficient, F-Ratio and Scheffe’s Multiple Range test.

Implication of the Study

These implications are put down as follows:

The planners of NABTEB syllabus should continue to retain the tasks in the formulation of syllabus in NTC electronic curriculum.Likewise emphasis should be placed seriously on practical skills more than or rather than knowledge. This is the only thing that can guarantee the necessary entry requirements for the students on electronic work. Lastly, theoretical knowledge should be de-emphasised in the formulation of assessment methods for electronic work students in colleges that are technically oriented. As it is, the developed instrument will be useful in all technical colleges to assess practical performances of students in electronic work.

Conclusion

Based on the NTC approved curriculum in Electronic Work (Appendix H), a test instrument for process assessment on electronic work performance was developed and validated. The reliability of the instrument was found to be 0.89 using Cronbach alpha coefficient. Evidence in the study proved that the instrument thus developed is of high validity and reliability because it satisfied all the psychometric properties that are essential for assessing students' practical performance in electronic tasks in Technical Colleges.

In addition, available data in this study showed sufficient evidence that there was a relative disparity among the raters, that is, B.Sc, HND and FTC. This difference among the raters, therefore, could not have occurred by chance, but rather due to the fact that the different groups of raters have different practical pedagogical exposures during their training in schools.

Recommendations

Based on the findings and conclusion of this study, the following recommendations are put forward:

1. This instrument should be used by electronic teachers to assess students' practical performance in electronic work in technical colleges in Nigeria.

2. The three test items and the tasks that had ratings below 3.50 cut-off point should not be used to assess students' practical work in electronic until they have been reviewed in further studies.

3. Seminar and workshops should be organized from time to time for electronic work teachers in technical colleges by the various State Post-Primary Education Boards for them to be familiarized with the methods of using this instrument. .

Suggestion for Further Research

This study could serve as a basis for similar studies on the development and validation of assessment instruments in other areas of study in the department of Technology and Vocational Education in Nigeria.

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INSTRUMENT FOR ASSESSING STUDENTS' PRACTICAL PERFORMANCE IN ELECTRONIC WORK IN TECHNICAL COLLEGES IN NIGERIA

GeneralObjectives of the Test Instrument

The general objectives of the test instrument are based on the students' ability to carry out the real tasks that are involved in electronic works. In other words, these objectives hinge on practical competence and generally include what the studentswill be able to do to show acquisition of knowledge in the field of electronic.

In general terms, students, after the completion of a module, should be able to use all tools correctly while ensuring the use of machinery guards and protective eye shields at all times. This is the general objective for identified task one of the NTC syllabus. For all other tasks, the specific learning outcomes arising from their objective have been spelt out (Appendix H).Aside fromthese; the specific objectives of every other tasks are detailed below as can be found in NTC curriculum in AppendixH.

Task 1:Electronic General Metalwork

Objectives of task 1:

1. Students will be able to use all tools correctly and ensure that eye shields are used at all times.
2. Students will be able to use and select hand tools for carryout various bench fitting and assembly task.
3. Students will be able perform metal joining by a range of processes including soldering, brazing, fusion,welding etc. Students will be able mark on metal and other materials, datum lines, angles and hole positions using a range of tools.

EWTI Tasks in General Metalwork

		Requirement					Year 1			Year 2			Year3		
SN		VS	S	MS	US	VU	Term 1	Term 2	Term 3	Term 1	Term 2	Term 3	Term 1	Term 2	Term 3
	Tasks Inventory to be included in EWTI														
	Tools						5	5	-	-	-	-	-	-	-
1	Ability to use tools and protective eye shield correctly														
2	Selection of hand tools for carrying out tasks.														
3	Correctly grind drill point angles to fix wires														
4	Cutting of breadboard to size using hacksaw														
5	Marking out of materials using a range of tools														
6	Effective use of types of files e.g. flat, square etc														

Task 2: Connection of Cells and other Electronic Components

Objectives of task 2: Students will be able to:

1. Identify and test for condition of primary cells.
2. Connect cells in series, parallel and series parallel
3. Connect resistor and capacitors in series, parallel, and series parallel

EWTI Tasks in Connection of Cells and other Electronic Components

		Requirement					Year 1			Year 2			Year3		
SN		VS	S	MS	US	VU	Term 1	Term 2	Term 3	Term 1	Term 2	Term 3	Term 1	Term 2	Term 3
	Tasks Inventory to be included in EWTI														
	Connection of cells and electronic components						-	-	-	2hrs	2hrs	3hrs	-	-	-
7	Ability to identify primary cells\														
8	Test for the condition of a cell or battery														
9	Ability to connect cells in series and parallel														
10	Series parallel connection of cells in a circuit														
11	Ability to connect resistors in series														
12	Ability to connect resistors in parallel														
13	Connection of resistors in series-parallel														
14	Ability to connect capacitors in series														
15	Correct connection of capacitors in series														
16	Connection of capacitors in parallel														

Task 3: **Use of Multi meter for Measurement Indication**

Objectives of task 3: Studentswill be able to:

1. identify functional parts of multi meter
2. Set and read the meter for AC, DC voltage measurement, circuit measurement, AC and DC current measurement.
3. Use the ohmmeter to test semiconductor devices.
4. Recognize fault condition of meters.

EWTI Tasks on the Use of Multi meter for Measurement Indication

		Requirement					Year 1			Year 2			Year3		
SN		**VS**	**S**	**MS**	**US**	**VU**	**Term 1**	**Term 2**	**Term 3**	**Term 1**	**Term 2**	**Term 3**	**Term 1**	**Term 2**	**Term 3**
	Tasks Inventory to be included in EWTI														
	Use of multi meter						-	-	-	1hr	2hrs	4hrs	-	-	-
17	Ability to identify the functional parts of multi meter														
18	Use of meter to read DC and AC voltage measurement														
19	Ability to read resistance measurement using meter														
20	Use meter to read AC and DC correct measurement														
21	Ability to use ohmmeter to test diodes and transistors														
22	Ability to identify fault in meters														
23	Ability to rectify fault in meters														
24	Ability to identify faulty components in electronic														

Task 4: Electronic Devices and Circuit Setup

Objectives of task 4: Students will be able to:

1. Set up rectifier circuit and build a simple smoothing circuit.
2. Apply filtering circuit at rectifier output.
3. Identify transistor types, PNP and NPN.
4. Set up laboratoryexperiment to plot characteristics of transistors.
5. Use meter to identify the type of transistors, test transistors andidentify the base, emitter and collector and transistor condition.

EWTI Tasks on Electronic Devices and Circuits Setup

		Requirement					**Year 1**			**Year 2**			**Year3**		
SN		VS	S	MS	US	VU	**Term 1**	**Term 2**	**Term 3**	**Term 1**	**Term 2**	**Term 3**	**Term 1**	**Term 2**	**Term 3**
	Tasks Inventory to be included in EWTI														
	Electronic devices and circuits set-up						-		-	-	-	-	3hrs	4hrs	4hrs
25	Ability to set up rectifier circuits														
26	Ability to build a simple smoothing circuit							-							
27	Ability to apply filtering circuit at rectifier output														
28	Ability to identify transistor type, PNP and NPN														
29	Setting up laboratory experiment to plot characteristics of transistors.														
30	Use of meter to identify the type of transistors														
31	Ability to use meter to test transistor terminals														
32	Correct use of meter to identity the base, emitter and collector and transistor condition														
33	Ability to identify various pins of a transistor														

Task 5: Integrated Circuits (ICs), Semiconductors, Oscilloscopes and Power Supply Unit

Objectives of task 5: Students will be able to:

1. Identify the functional parts of oscilloscopes.
2. Determine various waveforms by applying signals to the oscilloscope.
3. Assemble stabilized low-voltage power supply unit.
4. Identify: the place of power supply in a complex circuit, samples of capacitors and inductors used in power supply.
5. Exhibit power supply with transformer and without transformer.

EWTI Tasks on Integrated Circuit (ICs), Semiconductors, Oscilloscopes and Power Supply Unit

		Requirement					Year 1			Year 2			Year3		
SN		VS	S	MS	US	VU	Term 1	Term 2	Term 3	Term 1	Term 2	Term 3	Term 1	Term 2	Term 3
	Tasks Inventory to be included in EWTI														
	Use of ICs, semi conductors, oscilloscope, and power supply unit						-	-	-	-	3hrs	2hrs	3hrs	4hrs	4hrs
34	Ability to determine various waveforms by applying signals to the oscilloscope														
35	Ability to assemble stabilized low-voltage power supply unit														
36	Identification of the place of power supply in a complex circuit														
37	Ability to identify samples of capacitors and inductors used in power supply														
38	Exhibition of power supply with transformer														
39	Exhibition of power supply without transformer														

Task 6: Design of Simple Electronic Circuits

Objectives of task 6: Students will be able to:

1. Prepare circuit part lists, printed circuit board details, sheet metal details, etc
2. Construct simpleamplifier, oscillator and set-up a public address system.
3. Usesoldering iron and lead to join wires and component terminals together.
4. Identify simple logic circuit of AND, OR and NOT gates.
5. Apply safety regulation in electronic work practice.

EWTI Tasks on Design of Simple Electronic Circuits

		Requirement					Year1			Year 2			Year3		
SN		V S	S	MS	US	VU	**Term 1**	**Term 2**	**Term 3**	**Term 1**	**Term 2**	**Term 3**	**Term 1**	**Term 2**	**Term 3**
	Tasks Inventory to be included in EWTI														
	Design of simple electronic circuits						-	-	-	-	-	-	3hrs	4hrs	4hrs
40	Preparation of circuit part lists, printed circuit board details, sheet metal details, etc														
41	Ability to construct simple stage amplifier														
42	Ability to construct an oscillator														
43	Ability to use soldering iron and lead to join wires and component terminals together														
44	Ability to demonstrate the operation of a bistable multivibrator using switches and electronic bulbs														
45	Ability to construct a multivibrator circuit (flip flop)														
46	Identify simple logic circuit of AND, OR and NOT gates														
47	Ability to set up public address system														
48	Ability to operate a public address system														
49	Troubleshooting a faulty electronic gadgets														
50	Ability to rectify faulty address system														
51	Application of safety regulation in electronic work practice														

Appendix A
Letter for Validation of Instrument Developed

Tech. and Voc. Educ. Dept.
Nnamdi Azikiwe University,
Awka.
14th February, 2017.

Dear Sir/Madam,

REQUEST TO VALIDATE INSTRUMENT

A study is being carried out to develop and validate electronic test instrument for assessing students' practical performance in the subject area. The instrument attached here is to be validated.

You are please requested to assist in validating the developed instrument. Your comments and criticisms will be helpful to the study.

The purpose of the study, research questions, hypotheses and the questionnaire are attached to this letter.

Thanks so very much.

Yours faithfully,

Adekola Yinusa Adekunle

Appendix B

Introductory Letter for Data Collection

Tech. and Voc. Educ. Dept,
Nnamdi Azikiwe University,
Awka.
14th February, 2017.

Electronic Work Teachers
in Technical Colleges in
Delta State

Dear Sir,

DEVELOPMENT AND VALIDATION OF INSTRUMENT FOR ASSESSING STUDENTS' PRACTICAL PERFORMANCE IN ELECTRONIC WORK IN DELTA STATE TECHNICAL COLLEGES

A study is being carried out to develop and validate electronic test instrument for assessing students' practical performance in the subject area. Since technical college students are directly involved in the study, you, as the teacher, are requested to rate their performance using the attached instrument, following the attached instruction.

Please tick (   ) in the appropriate box 1-5, to indicate how well the students perform in each test item. In addition, make recommendations on how the instrument could be made valid.

Thank so very much.

….....................................	…..
Prof. K.R.E. Okoye	Adekola Yinusa Adekunle
Supervisor	2014197001F

Appendix C

Instrument for Data Collection

ELECTRONIC WORK TEST INSTRUMENT (EWTI) FOR ASSESSING STUDENTS' PRACTICAL PERFORMANCE IN ELECTRONIC WORK

This instrument is designed for assessing students' practical performance in electronics works in technical colleges. The instrument is divided into three sections A,B and C. In section A, check as it applies to you for section B and C, rate the students on a five-point sc ale in terms of the extent of practical performance thus:

Very Suitable	5
Suitable	4
Moderately Suitable	3
Unsuitable	2
Very Unsuitable	1

SECTION A

ACADEMIC QUALIFICATIONS FOR TECHNICAL TEACHERS

Please indicate by ticking (   ) your highest qualification.

B.Sc Industrial Technical Education (electronics option)

HND Electronics Technology plus PGDE

Full Technology Certificate in Electronics Technology plus TTC

Section B

Task 1: General metal work

S/No	Test Items	Rating Scales				
		5	4	3	2	1
1	Ability to use tools and protective eye shields correctly					
2	Selection of hand tools for carrying out tasks.					
3	Correctly grind drill point angles to fix wires					
4	Perform metal joining by soldering					
5	Cutting of breadboard to size using hack saw					
6	Marking out of materials using a range of tools					
7	Correctly handling and using portable power tools					
8	Effective use of types of files e.g. flat, square, etc.					

Task 2: Connection of cells and other electronic components

S/No	Test Items	Rating Scales				
		5	4	3	2	1
9	Ability to identify primary cells					
10	Test for the condition of a cell or battery					
11	Ability to connect cells in series and parallel					
12	Series- parallel connection of cells in a circuit					
13	Ability to connect resistors in series					
14	Ability connect resistors in parallel					
15	Connection of resistors in series - parallel					
16	Ability to connection of capacitors in series					
17	Correct connection of capacitors in series					
18	Connection of capacitors in parallel					

Task 3: Use of multimeter for measurement indication

S/No	Test Items	Rating Scales				
		5	4	3	2	1
19	Ability to identify the functional parts of multimeter					
20	Use of meter to read DC and AC voltage measurement					
21	Ability to read resistance measurement using meter					
22	Use of meter to read AC and DC current measurement					
23	Ability to use ohmmeter to test diodes and transistors					
24	Ability to identify fault in meters					
25	Ability to rectify fault in meters					
26	Ability to identify faulty components in electronic					

Task 4: Electronic devices and circuits set-up

S/No	Test Items	Rating Scales				
		5	4	3	2	1
27	Ability to set up rectifier circuits					
28	Ability to build a simple smoothing circuit					
29	Ability to apply filtering circuit at rectifier output					
30	Ability to identify transistor type PNP and NPN					
31	Setting up laboratory experiment to plot characteristics of transistors.					
32	Use of meter to identify the type of transistors					
33	Ability to use meter to test transistor terminals					
34	Correct use of meter to identity the base, emitter and collector and transistor condition					
35	Ability to identify various pins of a transistor.					

Task 5: Integrated circuit (ic), semiconductors, oscilloscopes and power supply unit

S/No	Test Items	Rating Scales				
		5	4	3	2	1
36	Identification of the functional parts of oscilloscopes					
37	Ability to determine various waveforms by applying signals to the oscilloscope					
38	Ability to assemble stabilized low-voltage power supply unit					
39	Identification of the place of power supply in a complex circuit					
40	Ability to identify samples of capacitors and inductors used in power supply					
41	Exhibition of power supply with transformer					
42	Exhibition of power supply without transformer					

Section C

Task 6: Design of simple electronic circuit

S/No	Test Items	Rating Scales				
		5	4	3	2	1
43	Preparation of circuit part lists, printed circuit board details, sheet metal details, etc					
44	Ability to construct simple stage amplifier					
45	Ability to construct an oscillator					
46	Ability to use soldering iron and lead to join wires and component terminals together					
47	Ability to demonstrate the operation of a bistable multivibrator using switches and electronic bulbs					
48	Ability to construct a multivibrator circuit (flip flop)					
49	Identify simple logic circuit of AND, OR and NOT gates					
50	Ability to set up a public address system					
51	Ability to operate a public address system					
52	Troubleshooting a faulty electronic gadgets					
53	Ability to rectify faulty address system					
54	Application of safety regulation in electronic work practice					

Appendix D
Departmental Letter of Introduction

NNAMDI AZIKIWE UNIVERSITY
AWKA

(VOCATIONAL AND TECHNICAL EDUCATION DEPARTMENT)

LETTER OF INTRODUCTION FOR CANDIDATE CARRYING OUT RESEARCH WORK

Adekola Yinusa Adekunle is a Postgraduate student of the Vocational and Technical Education Department Nnamdi Azikiwe University Awka. He is currently undertaking research work on:

“Development and validation of instrument for assessing students’ practical performance in electronic work in technical Colleges”

It would be appreciated if you could supply him the needed information he may require from you. All information from you will be treated confidentially.

Thank you very much for your co-operation.

Mrs. J.I. Ezenwafor, Ph.D
Head of Department

Appendix E
Harrow's (1972) Table of Specifications

Reflex movement (RM)

Basic Fundamental movement (BFM)

Perceptual Abilities (PA)

Physical Abilities (PH.A)

Skilled movements (SM)

Non-discursive Communication (NDC)

		Psychomotor/Practical level						
S/N	Tasks	RM	BFM	PA	PH.A	SM	NDC	TOTAL
1	General metal work	1	1	1	2	2	1	8
2	Connection of cells and other components	1	2	1	2	2	1	9
3	use of multimeter for measurement indication	.	2	2	3	3	1	11
4	Electronic devices and circuit set-up	1	2	2	2	2	1	10
5	Integrated circuit, semiconductors, oscilloscopes and power supply unit	1	2	2	2	2	1	10
6	Design of simple electronic circuits		1	2	1	2		6
	Total	4	10	10	12	13	5	54

Appendix F
SPSS Output for the Research Questions and Hypotheses

TASK 1

Means

Qualification	Mean	N	Std. Deviation
B. Sc.	3.000	8	0.370
HND	3.516	8	0.344
FTC	4.205	8	0.288
TOTAL		24	

Oneway ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5.848	2	2.924	25.89	0.000
Within Groups	2.372	21	0.113		
Total	8.220	23			

TASK 2

Means

Qualification	Mean	N	Std. Deviation
B. Sc.	3.320	10	0.253
HND	3.565	10	0.259
FTC	4.251	10	0.167
TOTAL		30	

Oneway ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.658	2	2.329	43.97	0.000
Within Groups	1.430	27	0.053		
Total	6.088	29			

TASK 3

Means

Qualification	Mean	N	Std. Deviation
B. Sc.	3.500	8	0.239
HND	4.196	8	0.310
FTC	3.641	8	0.380
TOTAL		24	

Oneway ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups Within Groups Total	2.167 2.085 4.253	2 21 23	1.084 0.099	10.91	0.001

TASK 4

Means

Qualification	Mean	N	Std. Deviation
B. Sc.	3.444	9	0.219
HND	3.641	9	0.309
FTC	4.301	9	0.179
TOTAL		27	

Oneway ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups Within Groups Total	3.624 1.404 5.028	2 24 26	1.812 0.058	30.99	0.000

TASK 5

Means

Qualification	Mean	N	Std. Deviation
B. Sc.	3.029	7	0.335
HND	3.520	7	0.316
FTC	4.337	7	0.164
TOTAL		21	

OnewayANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups Within Groups Total	6.117 1.435 7.552	2 18 20	3.059 0.080	38.36	0.000

TASK 6

Means

Qualification	Mean	N	Std. Deviation
B. Sc.	3.633	12	0.518
HND	3.877	12	0.282
FTC	4.452	12	0.223
TOTAL		36	

One wayANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.238	2	2.119	16.01	0.000
Within Groups	4.368	33	0.132		
Total	8.606	35			

Post Hoc Test

TASK 1

Multiple Comparisons

	Qualifications (A)	(B)	Mean Difference (A – B)	Std. Error SE	Sig. P-value
Scheffe	BSC	HND	-0.516	0.12	0.013
		FTC	-1.205	0.10	0.000
	HND	BSC	0.516	0.12	0.013
		FTC	-0.689	0.10	0.001
	FTC	BSC	1.205	0.10	0.000
		HND	0.689	0.10	0.001

	Qualifications		95% Confidence Interval	
	(A)	(B)	Lower Bound	Upper Bound
Scheffe	BSC	HND	-0.902	-0.130
		FTC	-1.563	-0.847
	HND	BSC	0.130	0.902
		FTC	-1.032	-0.346
	FTC	BSC	0.847	1.563
		HND	0.346	1.032

The Mean Difference is significant at 0.05 levels

TASK 2

Multiple Comparisons

	Qualifications (A)	(B)	Mean Difference (A – B)	Std. Error SE	Sig. P-value
Scheffe	BSC	HND	-0.245	0.080	0.047
		FTC	-0.931	0.053	0.000
	HND	BSC	0.245	0.080	0.047
		FTC	-0.686	0.082	0.000
	FTC	BSC	0.931	0.053	0.000
		HND	0.686	0.082	0.000

	Qualifications		95% Confidence Interval	
	(A)	(B)	Lower Bound	Upper Bound
Scheffe	BSC	HND	-0.486	-0.004
		FTC	-1.1354	-0.7266
	HND	BSC	0.004	0.486
		FTC	-0.8936	-0.4784
	FTC	BSC	0.7266	1.1354
		HND	0.4784	0.8936

The Mean Difference is significant at 0.05 levels

TASK 3

Multiple Comparisons

	Qualifications (A)	(B)	Mean Difference (A – B)	Std. Error SE	Sig. P-value
Scheffe	BSC	HND	-0.141	0.11	0.326
		FTC	-0.696	0.13	0.001
	HND	BSC	0.141	0.11	0.326
		FTC	-0.555	0.13	0.007
	FTC	BSC	0.616	0.13	0.001
		HND	0.555	0.13	0.007

	Qualifications		95% Confidence Interval	
	(A)	(B)	Lower Bound	Upper Bound
Scheffe	BSC	HND	-0.440	0.158
		FTC	-1.046	-0.347
	HND	BSC	-0.158	0.440
		FTC	-0.930	-0.180
	FTC	BSC	0.347	1.046
		HND	0.180	0.930

The Mean Difference is significant at 0.05 level

TASK 4

Multiple Comparisons

	Qualifications (A)	(B)	Mean Difference (A – B)	Std. Error SE	Sig. P-value
Scheffe	BSC	HND	-0.197	0.073	0.042
		FTC	-0.857	0.060	0.000
	HND	BSC	0.197	0.073	0.142
		FTC	-0.660	0.10	0.000
	FTC	BSC	0.857	0.60	0.000
		HND	0.660	0.10	0.000

	Qualifications		95% Confidence Interval	
	(A)	(B)	Lower Bound	Upper Bound
Scheffe	BSC	HND	-0.468	0.074
		FTC	-1.0573	-0.6561
	HND	BSC	-0.074	0.468
		FTC	-0.920	-0.400
	FTC	BSC	0.6561	1.0573
		HND	0.400	0.920

The Mean Difference is significant at 0.05 level

TASK 5

Multiple Comparisons

	Qualifications (A)	(B)	Mean Difference (A – B)	Std. Error SE	Sig. P-value
Scheffe	BSC	HND	-0.491	0.13	0.017
		FTC	-1.309	0.062	0.000
	HND	BSC	0.491	0.13	0.017
		FTC	-0.817	0.12	0.000
	FTC	BSC	1.309	0.062	0.000
		HND	0.817	0.12	0.000

	Qualifications		95% Confidence Interval	
	(A)	(B)	Lower Bound	Upper Bound
Scheffe	BSC	HND	-0.875	-0.108
		FTC	-1.634	0.983
	HND	BSC	0.108	0.875
		FTC	-1.127	-0.507
	FTC	BSC	0.983	1.634
		HND	0.507	1.127

The Mean Difference is significant at 0.05 level

TASK 6

Multiple Comparisons

	Qualifications (A)	(B)	Mean Difference (A – B)	Std. Error SE	Sig. P-value
Scheffe	BSC	HND	-0.243	0.15	0.171
		FTC	-0.818	0.064	0.000
	HND	BSC	0.243	0.15	0.171
		FTC	-0.575	0.081	0.000
	FTC	BSC	0.818	0.064	0.000
		HND	0.575	0.081	0.000

	Qualifications		95% Confidence Interval	
	(A)	(B)	Lower Bound	Upper Bound
Scheffe	BSC	HND	-0.602	0.116
		FTC	-1.167	-0.469
	HND	BSC	0.116	0.602
		FTC	-0.791	-0.359
	FTC	BSC	0.469	1.167
		HND	0.359	0.791

The Mean Difference is significant at 0.05 level

Appendix G

Reliability Test Results

```
RELIABILITY
 /VARIABLES=Item1 Item2 Item3 Item4 Item5 Item6 Item7 Item8
 /SCALE('ALL VARIABLES') ALL
 /MODEL=ALPHA
 /STATISTICS=DESCRIPTIVE SCALE.
```

Reliability for Task 1

Scale: ALL VARIABLES

Case Processing Summary

		N	%
	Valid	30	100.0
Cases	Excluded	0	.0
	Total	30	100.0

a. List wise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.964	8

Item Statistics

	Mean	Std. Deviation	N
Item1	4.3333	1.02833	30
Item2	4.0000	.74278	30
Item3	4.4000	.93218	30
Item4	4.3333	.71116	30
Item5	3.8000	1.06350	30
Item6	3.8667	1.07425	30
Item7	3.7333	1.17248	30
Item8	3.6667	1.24106	30

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
32.1333	52.395	7.23847	8

```
RELIABILITY
 /VARIABLES=Item1 Item2 Item3 Item4 Item5 Item6 Item7 Item8 Item9 Item10
 /SCALE('ALL VARIABLES') ALL
 /MODEL=ALPHA
 /STATISTICS=DESCRIPTIVE SCALE.
```

Reliability for Task 2

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	30	100.0
	Excluded[a]	0	.0
	Total	30	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.951	10

Item Statistics

	Mean	Std. Deviation	N
Item1	4.3667	.92786	30
Item2	3.8000	.96132	30
Item3	4.6333	.66868	30
Item4	4.7000	.79438	30
Item5	4.2667	.73968	30
Item6	4.5667	.67891	30
Item7	4.0000	1.14470	30
Item8	4.2667	.73968	30
Item9	4.5667	.67891	30
Item10	4.0000	1.14470	30

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
43.1667	59.661	7.72405	10

```
RELIABILITY
  /VARIABLES=Item1 Item2 Item3 Item4 Item5 Item6 Item7 Item8
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA
  /STATISTICS=DESCRIPTIVE SCALE.
```

Reliability for Task 3
Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	30	100.0
	Excluded[a]	0	.0
	Total	30	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.848	8

Item Statistics

	Mean	Std. Deviation	N
Item1	4.3000	.98786	30
Item2	3.6000	1.19193	30
Item3	4.4667	1.13664	30
Item4	5.0000	.00000	30
Item5	3.5000	1.27982	30
Item6	4.3000	1.36836	30
Item7	3.8333	1.55549	30
Item8	3.2000	1.32353	30

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
32.2000	44.097	6.64052	8

```
RELIABILITY
 /VARIABLES=Item1 Item2 Item3 Item4 Item5 Item6 Item7 Item8 Item9
 /SCALE('ALL VARIABLES') ALL
 /MODEL=ALPHA
 /STATISTICS=DESCRIPTIVE SCALE.
```

Reliability for Task 4

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	30	100.0
	Excluded[a]	0	.0
	Total	30	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.863	9

Item Statistics

	Mean	Std. Deviation	N
Item1	4.5000	.90019	30
Item2	3.8667	1.10589	30
Item3	4.7333	.78492	30
Item4	5.0000	.00000	30
Item5	3.7333	1.28475	30
Item6	4.6000	1.13259	30
Item7	4.1333	1.45586	30
Item8	3.9667	1.47352	30
Item9	3.6000	1.35443	30

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
38.1333	50.326	7.09411	9

```
RELIABILITY
  /VARIABLES=Item1 Item2 Item3 Item4 Item5 Item6 Item7
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA /STATISTICS=DESCRIPTIVE SCALE.
```

Reliability for Task 5
Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	30	100.0
	Excluded[a]	0	.0
	Total	30	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.944	7

Item Statistics

	Mean	Std. Deviation	N
Item1	3.4667	1.13664	30
Item2	3.3667	1.24522	30
Item3	4.1333	.97320	30
Item4	4.2333	1.13512	30
Item5	4.0333	.92786	30
Item6	4.0667	.98027	30
Item7	3.4000	1.35443	30

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
26.7000	51.459	7.17347	7

```
RELIABILITY

 /VARIABLES=Item1 Item2 Item3 Item4 Item5 Item6 Item7 Item8 Item9 Item10 Item11 Item12
 /SCALE('ALL VARIABLES') ALL
 /MODEL=ALPHA
 /STATISTICS=DESCRIPTIVE SCALE.
```

Reliability for Task 6

[DataSet0]

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	30	100.0
	Excluded[a]	0	.0
	Total	30	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.911	12

Item Statistics

	Mean	Std. Deviation	N
Item1	4.1667	1.01992	30
Item2	4.1667	.74664	30
Item3	3.6000	1.16264	30
Item4	3.7000	.95231	30
Item5	3.6667	1.12444	30
Item6	3.5000	1.16708	30
Item7	3.2667	.94443	30
Item8	3.2000	1.18613	30
Item9	3.8333	1.08543	30
Item10	3.9333	1.20153	30
Item11	3.6000	1.13259	30
Item12	3.8667	.93710	30

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
44.5000	105.776	10.28474	12

RELIABILITY TEST

```
RELIABILITY
  /VARIABLES=Item1 Item2 Item3 Item4 Item5 Item6 Item7 Item8
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA
  /STATISTICS=DESCRIPTIVE
```

Appendix H

NTC Curriculum

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

ED/STV/2001/PI/

Radio, TV & Electronic Work

National Technical Certificate (NTC) and Advanced National Technical Certificate (ANTC)

Curriculum and Course Specifications

NATIONAL BOARD FOR TECHNICAL EDUCATION
Federal Republic of Nigeria

UNESCO – Nigeria Project

2001

PROGRAMMES AVAILABLE IN NIGERIA POLYTECHNIC, MONOTECHNICS, COLLEGES OF TEALTH TECHNOLOGY, INNOVATION ENTERPRISES INSTITUTIONS VOCATIONAL ENTERPRISES INSTITUTIONS AND TECHNICAL COLLEGES AS AT JUNE 2012.

These programmes are currently being offered at National Diploma (ND)- sub degree level. Higher National Diploma (HND) –degree level and Post –HND- postgraduate professional level in higher technical institutions.

Agricultural and Related Technology

- Agricultural Engineering Technology
  Agricultural Extension and management
  Agricultural Technology (General Agriculture)
  Animal Health & Production Technology
  Animal Health Technology
  Animal Production Technology
  Crop Production Technology
  Fisheries Technology
  Forestry Technology
  Horticulture & Landscape Technology
  Pest Management Technology
  Soil Science & Technology
  Wild Life Management
  Wood Paper Technology

Art, Design and Related Technology

- Art and Industrial Design
  Fashion Design and Clothing Technology
  Printing Technology
  Music Technology

Business and Related Studies

- Business Administration and Management
  Bilingual Secretarial Studies
  Cooperative Economics and Management
  Human Resources Management
  Local Government Studies
  Maritime transport and Business Studies
  Marketing
  Office Technology & Management
  Petroleum Marketing & Business Studies
  Public Administration
  Purchasing and Supply
  Social Development

Engineering Technology

- Aircraft Engineering Technology
  Boat and Ship Building Engineering Technology
  Chemical Engineering Technology

Networking and system Security

Telecommunication technology

OIL AND GAS RELATED SECTOR

Petroleum Geosciences

PARALEGAL AND RELATED SECTOR

Paralegal Studies

PROFESSIONAL DEVELOPMENT TEACHING AND RELATED SECTOR

Early Childcare Education and Management (ECEM)

SECURITY TECHNOLOGY AND RELATED SECTOR

Security Management and Technology

LIST OF PROGRAMMES AVAILABLE IN TECHNICAL COLLEGES AS AT JUNE 2012

1. **Automobile Trade**

- Agricultural Implement Mechanics
- Auto Electric Works
- Motor Vehicle Mechanics
- Vehicle Body Building

2 **Building and Wood Work Trades**

- Block-laying, Brick-laying & Concreting
- Carpentry and Joinery
- Draftsmanship Craft Practice
- Furniture Design & Construction
- Machine Wood Working
- Painting & Decorating

3 **Business Trades**

- Business Studies
- Parts Merchandising
- Typewriting
- Stenography

4 **Computer Trades**

- Computer Maintenance & GSM Repairs
- Computer Studies

5 Electrical/ Electronic Trades

- Applied Maintenance & Repairs
- Electrical Installation and Maintenance Works
- Instrument Mechanics
- Radio, Television & Electronic Work

6 **Hospitality Trades**

Catering Craft practice

7 **Mechanical Trades**Fabrication and Welding

General Metal Work I

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN RADIO, TV & ELECTRONIC WORK		
Course: General Metal Work I	Course Code: CME 11	Contact Hours: 168 HRS
Module Specification: PRACTICAL/KNOWLEDGE REQUIREMENTS		

General Objective: On completion of this module the student will be able to:

1. Understand workshop safety rules and their application in machine shop.
2. Know the physical properties, manufacturing process and application of ferrous and non-ferrous metals in common use.
3. Select and use common measuring, marking out, cutting and striking tools.
4. Understand the basic working principles of drilling machine and be able to use it for various types of screw threads, rivets, and be able to rivet and cut screws by hand.
5. Understand the application of various types of screw threads and rivets, and be able to rivet and cut screws by hand.
6. Understand the ISO system of tolerances and fits their application in engineering production.
7. Produce simple engineering components on the bench.
8. Understand the essential features and working principles of the center, lathe and carry out basic operations such as turning, stepped turning, facing, taper turning, knurling, chamfering and undercutting.

Practical Competence: On completion of this module, the student will be able to:

1. Use all tools correctly ensuring the machinery guards and protective eye shields are used at all times.
2. Comply with the general rules for safe practice in the work environment at all times.
3. Use and select hand tools for carrying out various bench fitting and assembly tasks.
4. Tools: hacksaws, taps, reamers, drills, dividers, surface gauge
5. Produce threads using taps and dies
6. Correctly grind drill point angles: Drills: twist and flat drills
7. Select and set drilling machine speeds to carry out a range of operations using the appropriate coolants. Drilling, reaming, counter sinking, counter boring.
8. Perform metal joining by a range of processes. Cut through the joints and investigate the depth of penetration of the metals at the interface. Processes: Soldering, brazing, and fusion welding.
9. Mark out on metals and other materials, datum lines, angles, radii/circles and hole positions using a range of tools.

PRACTICAL TASKS

PROGRAMME NATIONAL TECHNICAL CERTIFICATE IN RADIO, TV & ELECTRONIC WORK			
	General Objective 1.0: Safety and Practice		
Week	Specific Learning Outcome	Teachers Activities	Resource
1 – 3	1.1 Using and handling hand tools, portable power tools and machine 1.2 Lifting, moving and storing materials or job 1.3 Demonstrate first aid application in cases of minor cuts, electric shock, Burns	• Demonstrate safe ways of handling basic hand tools • Show a film in industrial safety • Demonstrate how to treat energy cases like artificial respiration cold compress, etc • Assess the student	• Hand tools files hacksaw • Television, Video machines • Posters on artificial respiration
	General Objective 2.0: Measuring, Marking, Cutting and striking		
Week	Specific Learning Outcome	Teachers Activities	Resource
	2.1 Describe the essential features and use of the following a. micrometer b. Vernier caliper c. Vernier height gauge d. Combination set 2.2 Maintain and care for the instruments listed above 2.3 Perform making out exercise on plane surface including profiles 2.4 File a piece of metal to given specifications using any of the following: Cross filing, draw filing, filing square and flat surfaces 2.5 Test surface for flattens using surface plate and try square and state precautions to be taken to avoid Pinning 2.6 Maintain files in good working Conditions 2.7 Apply various hammers and mallets e.g. ball pein, rubber mallets, etc for engineering purposes	• Demonstrate how to use micrometer, vernier caliper vernier height gauge, combination set • Demonstrate the maintenance and care of the instruments listed above • Perform marking out for the students to learn and practice till they become competent • Demonstrate how flat surface can be tested using surface plate and try square • Demonstrate how files are cleaned and state the precautions to be taken against pinning. Students to practice till they become competent • Demonstrate the application of hammers and mallets for engineering purposes • Demonstrate how a hacksaw blade can be inserted correctly	• Micrometer, vernier caliper vernier height gauge, combinations sets • Steel rules, dividers, punches, trammel, scribe angle plate, vee block center square • Flat file hand file, square • file card, flat file • Ball pein hammers, mallet • Hacksaw bald, Hacksaw frame

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	General Objective 2.0: Measuring, Marking, Cutting and striking		
Week	Specific Learning Outcome	Teachers Activities	Resource
	2.8 Select and insert hacksaw blade correctly 2.9 Cut metal and other engineering materials to a given specification using the adjustable hacksaws, junior hacksaws, piercing saw, etc	• Demonstrate how to use adjustable hacksaw, junior hacksaw piercing • Students should be allowed to practice till they become competent • Guide student to produce simple • engineering component like opened ended spanner, engineers square tool makers clamp, centre square, etc • Assess the student	
	General Objective 3.0: Machine Tools		
Week	Specific Learning Outcome	Teachers Activities	Resource
7-9	3.1 Set up and operate a drilling machine in given situations Note Setting up drilling machine should include a. change of spindle speed b. adjustment of drilling table to require height and angle, holding of work on drilling bale to required height and angle using appropriate clamping device. c. Install up the drill bit in chuck 3.2 Sharpen a twist drill correctly to manufacturers specification	• Demonstrate how to set up and operate a drilling machine in given situation • Students to practice till they become competent • Demonstrate how a twist drill can be sharpened correctly • Demonstrate with the appropriate facility how to perform all the drilling operations • Students to practice till they become competent • Give notes as well as demonstrate the operation sequence in cutting internal (through and blind) and external threads by hand method	• Bench drill, pillar drill, twist drill, flat drill, counter sink drill, counter bore drill, center drill, drill bits. • Drills taps, tap wrench die and die stock • Rivets and sets of drill bits • Surface table, surface plate marking solution, center/dot punches, scribing block

Basic Electricity

PROGRAMME:	NATIONAL TECHNICAL CERTIFICATE IN RADIO, TV & ELECTRONIC WORK
MODULE:	CEI II - Basic Electricity
DURATION:	72 Hours
GOAL:	This module is designed to provide the trainee with basic knowledge of electricity and the competency to wire simple circuits and use common electrical measuring instruments.

GENERAL OBJECTIVES:

On completion of this module, the trainee should be able to:

1.0 Understand the structure of matter and its relevance to electricity/electronics.
2.0 Understand the chemical sources of electromotive force.
3.0 Understand the construction of resistors, inductors and capacitors and explain their functions in a simple circuit
4.0 Know the values of resistor(s).
5.0 State Ohm's Law and apply it to calculate resistance, voltage and current. 6.0 Distinguish between AC and DC current and voltage.
7.0 Understand the principles of transformer, its construction and operation. 8.0 Analyse, connect and carry out simple calculation on simple electrical circuit. 9.0 Interpret basic electronic signs and symbols.
10.0 Understand the operation, uses and limitations of indicating instruments and operate them.

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Course: CEI II - BASIC ELECTRICITY	Course Code: CEI II	Contact Hours: 2-1 HRS	
Course specification: Theoretical Content Year I, Term I			
	General Objective 5.0: State Ohm's law andapply it to calculate resistance, voltage and current, Year 1 Term 2 Contact Hour: 1-2		
Week	Specific Learning Outcome:	Teachers Activities	Resources
1-7	5.1 Define Ohm's law 5.2 Calculate Resistance, Voltage or Current using Ohm's law e.g. R = V/I 5.3 Connect: a. resistors in series b. resistors in parallel c. series and parallel connection 5.4 Connect: a. batteries in series b. batteries in parallel c. batteries in series-parallel connection 5.5 Connect capacitors in series and parallel and capacitors in series parallel connection as above. 5.6 State the implication of the connections mode in 5.3 - 5.5 5.7 Calculate the inductance, capacitance connected in series and parallel. 5.8 Define Kirchoff's laws: - a. Current law b. Voltage law 5.9 Solve simple numerical problems involving 5.8(a) & 5.8(b) above. 5.10 Define Superposition theorem 5.11 Solve simple numerical problems to illustrate Superposition theorem	• Define Ohm's Law • Work some calculations on Ohm's law • Show how resistor can be connected in series, parallel and series-parallel and perform calculations. • Refer students to batteries connected in the three modes by asking questions. • Show capacitor in series, parallel and in series-parallel. • Explain the implication of modes 5.3 - 5.6 • Work samples of Capacitors and inductor in series parallel. • Define the laws. Use vector diagram to explain the current law e.g. $I_1 + I_2 + I_5 = I_3 + I_4$ • Define the voltage laws. Draw a simple circuit to illustrate the law, • State the laws. Draw a simple circuit to illustrate the law • Super position theorem. Use simple circuit to illustrate the theorem.	

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Course: CEI II - BASIC ELECTRICITY	Course Code: CEI II	Contact Hours: 2-1 HRS	
Course specification: Theoretical Content Year I, Term I			
	General Objective 10.0: Understand the operation, uses and limitations of indicating instruments and operate them.		
Week	Specific Learning Outcome:	Teachers Activities	Resources
3-13	10.1 Describe the functional part of the multi-meter 10.2 Set and read the meter for: a. AC and DC voltage measurement b. Resistance measurement c. AC and DC current measurement 10.3 Use the Ohmmeter to test semi-conductor devices. 10.4 Recognize a fault condition of meter	• Describe the parts, operation and uses of multimeter. • Demonstrate how to use the instrument in measuring current voltage and resistance both on AC and DC • Show how to use the multimeter to test diode, transistors etc. • Explain how to identify fault and how to rectify such.	• Multimeter - digital and Analogue • Ohmmeter • Chalkboard • Note. • Chalk Board • Diode • Transistor

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN RADIO, TELEVISION AND ELECTRONIC WORK

COURSE: CRT 13 RADIO COMMUNICATION		Course Code: CRT 13	Contact Hours: 3-2
Course Specification Practical Content Year 2, Term 3			
	2.7 Identify the following faults finding equipment: a. Signal tracer b. Signal generator c. IF sweep generator d. Meters e. Loop antenna f. Frequency counter g. Non-magnetic screw driver		• Signal tracer, signal generator, if sweep generator, meters, loop antenna, frequency counter and Non-magnetic screwdriver.
	General Objective 2.0: Know how to trouble shoot or trace faults and repair radio sets. Year 3, Term 2. Contact Hours: 1-4		
Week	Specific Learning Outcome:	Teachers' Activities	Resources
1-13	2.8 Explain/Describe the faultfinding technique in radio servicing. 2.9 Diagnose fault in a radio receiver using faultfinding technique. 2.10 Repair and maintain radio receiver observing safety precautions. 2.11 Align a radio receiver as specified by the manufacturers features.	• List faultfinding techniques (I) check the plug manpower supply flow chart technique signal tracing technique signal injecting, etc. • Teacher creates faults in radio set for students to trace the faults. • Provide sets for faultfinding and repairs. • Demonstrate (alignment of IF & RF using the necessary equipment and tools for FM & AM radio receivers.	• Flow chart, signal tracer, signal Injector. • Signal tracer, signal generator, IF sweep generator, meters loop antenna, frequency counter and Non-magnetic screwdrivers. • IF signal generator for both AM & FM, FM radio receiver AM radio receiver power supply.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN RADIO, TELEVISION AND ELECTRONIC WORK			
COURSE: CRT 13 RADIO COMMUNICATION		Course Code: CRT 13	Contact Hours: 3-2
Course Specification Practical Content Year 2, Term 3			
	General Objective 2.0: Know how to trouble shoot or trace faults and repair radio sets Year 3, Term 3 Contact Hour: 1-4		
Week	Specific Learning Outcome:	Teachers' Activities	Resources
1-13	2.12 Dismantle and re-assemble power supply stage in radio set. 2.13 Dismantle and re-assemble RF stage in a radio set. 2.14 Dismantle and re-assemble IF and detector stage. 2.15 Dismantle and re-assemble AF Amp and L/Speaker. 2.16 Install and maintain a car radio 2.17 Differentiate between the various types of aerials used in radio and TV receptions. 2.18 Construct different types of aerials used in radio & TV. 2.19 Operate and use the following equipment to clear fault in a radio set: a. Signal tracer b. Signal generator c. IF sweep generator d. Meters e. Loop antenna f. Frequency counter g. Non-magnetic screw Drivers	• Explain the process of dismantling and re-assembling power supply in a radio set. • Explain the process of dismantling, and re-assembling RF stage in a radio set. • Explain the process of dismantling and re-assembling these stages in a radio set. • Explain the process involved in dismantling and re-assembling these stages. • Explain the process involved in installing and maintaining a car radio. • Explain and identify the parts, functions of various types of aerials used in radio & TV reception. • Explain the process involved and also state the materials.	• Radio set, screwdrivers. • Car radio, screwdrivers, spanners. • Various types of aerial and schematic diagrams. • Signal tracer, signal generator, IF sweep generator meters, loop antenna, frequency counter and non-magnetic screwdriver.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN RADIO, TELEVISION AND ELECTRONIC WORK

COURSE: CRT 14 RADIO & AUDIO FREQUENCY AMPLIFIERS		Course Code: CRT 14	Contact Hours: 3-2
Course Specification: Practical Content YEAR 2, TERM 3			
Week	Specific Learning Outcome: At the end of this model the students should be able to perform the following tasks:	Teachers' Activities	Resources
1-12	EXPERIMENT I a. Dismantle and re-assemble power supply in a radio set. b. Dismantle and re-assemble RF stage in a radio set. c. Dismantle and re-assemble IF and detector stages in a radio set. d. Dismantle and re-assemble AF amplifier stage and loudspeaker. e. Install and maintain a car radio. f. Identify type aerials used in radio and TV and their parts.		• Make available appropriate tools.

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COURSE: CRT 14 RADIO & AUDIO FREQUENCY AMPLIFIERS	**Course Code: CRT 14**	**Contact Hours: 3-2**

Course Specification: Practical Content YEAR 2, TERM 3

Week	**Specific Learning Objective: At the end of this model the students should be able to perform the following tasks:**	**Teacher's Activities**	
1-12	**EXPERIMENT II** a. FM and AM demonstration receivers to be distinguished b. Explain the differences between FM and AM radios set schematic diagram. c. Introduce fault finding equipment d. Signal tracer, signal generator, IF sweep generator, meters, loop antenna, frequency counter and non-magnetic tools for RF tuning. e. Demonstrate how to use the equipment listed in Week 5 to diagnose faults in a radio set. f. Observe safety precautions while repairing and maintaining radio receiver. g. Alignment of IF and RF using necessary equipment: - IF signal generator and power Supply		